DEPARTMENT OF THE ARMY TECHNICAL MANUAL

DEPARTMENT OF THE AIR FORCE TECHNICAL ORDER

TM 11-976A

TO 16-35PU26-6

POWER UNIT

PU-26A/U

DEPARTMENTS OF THE ARMY AND THE AIR FORCE

JULY 1954

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SAFETY NOTICE

Do not attempt adjustments or changes on wiring while the equipment is in operation. Be sure to open the circuit breaker before making or changing load connections. This unit generates sufficient voltage to cause severe and possibly fatal shock. Use extra caution when operating on wet or damp ground.

Be sure to provide proper ventilation when operating the unit in a confined space. *Exhaust gases are poisonous and excessive inhalation may cause severe sickness or death.*

Do not service with gasoline while the equipment is in operation.

TECHNICAL MANUAL
No. 11–976A
TECHNICAL ORDER
No. 16–35PU26–6

DEPARTMENTS OF THE ARMY AND
THE AIR FORCE

WASHINGTON 25, D. C., *1 July 1954*

POWER UNIT PU–26A/U

		Paragraph	*Page*
CHAPTER 1.	INTRODUCTION		
Section I.	General	1, 2	3
II.	Description and data	3–8	3
CHAPTER 2.	OPERATING INSTRUCTIONS		
Section I.	Service upon receipt of equipment	9–17	11
II.	Controls and instruments	18–20	17
III.	Operation under usual conditions	21–26	24
IV.	Operation under unusual conditions	27–30	29
CHAPTER 3.	ORGANIZATIONAL MAINTENANCE INSTRUCTIONS		
Section I.	Organizational tools and equipment	31, 32	33
II.	Lubrication and preservation	33–39	33
III.	Preventive maintenance	40–46	39
IV.	Theory and troubleshooting	47–49	46
CHAPTER 4.	FIELD MAINTENANCE INSTRUCTIONS		
Section I.	Cleaning, stripping, and inspecting	50–55	62
II.	Disassembly	56–58	89
III.	Reassembly	59–61	103
IV.	Adjustments and final testing	62, 63	114
V.	Refinishing and suppression	64, 65	116
CHAPTER 5.	SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE.	66–69	121
INDEX		-----	122

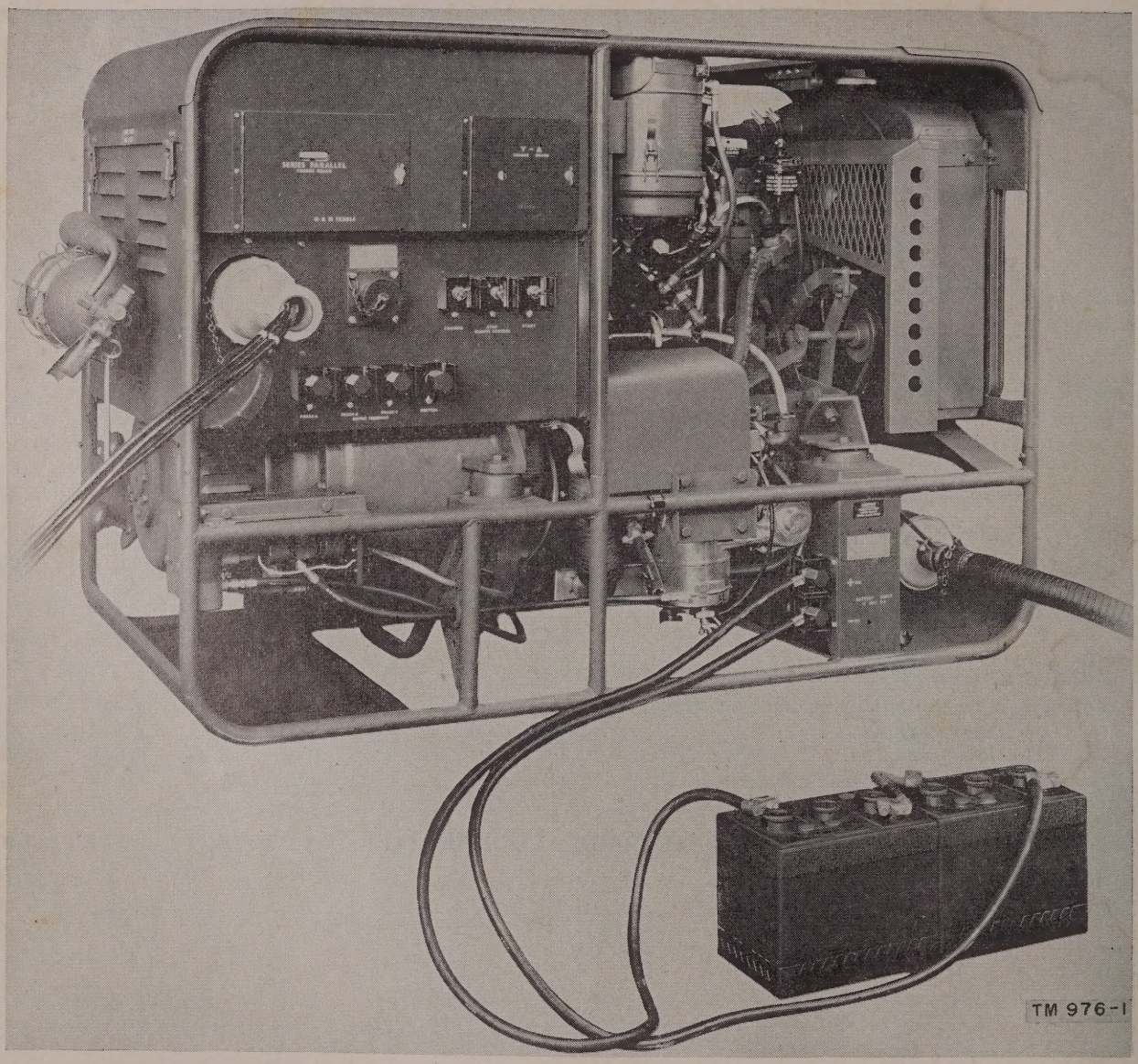


Figure 1. Power Unit PU–26A/U.

CHAPTER 1
INTRODUCTION

Section I. GENERAL

1. Scope

These instructions are published for the information of all concerned. They include complete information for operating, servicing, maintaining, and overhauling the equipment. Also included are a detailed description of all major parts and a discussion of the theory of operation.

2. Forms and Records

a. The following forms will be used for reporting unsatisfactory conditions of Army materiel and equipment and in performing preventive maintenance.

(1) DD Form 6, Report of Damaged or Improper Shipment, will be filled out and forwarded as prescribed in SR 745–45–5 (Army), Navy Shipping Guide, Article 1850–4, and AFR 71–4 (Air Force).

(2) DA Form 468, Unsatisfactory Equipment Report, will be filled out and forwarded to the Office of the Chief Signal Officer, as prescribed in SR 700–45–5.

(3) DD Form 535, Unsatisfactory Report, will be filled out and forwarded to Commanding General, Air Materiel Command, Wright-Patterson Air Force Base, Dayton, Ohio, as prescribed in SR 700–45–5 and AFR 65-26.

(4) DA Form 11–260, Operator First Echelon Maintenance Check List for Signal Corps Equipment (Power Units, Reel Units (Engine-Driven), will be used in accordance with instructions appearing on the form.

(5) DA Form 11–261, Second and Third Echelon Maintenance Check List for Signal Corps Equipment (Power Units, Reel Units (Engine-Driven), will be used in accordance with instructions appearing on the form.

b. The following forms, explained in TM 37–2810, will be used in connection with the operation and maintenance of Signal Corps internal-combustion-engine driven equipment.

(1) DA Form 460 (Preventive Maintenance Roster).

(2) DA Form 464 (Worksheet for Preventive Maintenance and Technical Inspection of Engineer Equipment).

c. Use other forms and records as authorized.

Section II. DESCRIPTION AND DATA

3. Description of Power Unit PU–26A/U

Power Unit PU–26A/U consists of a revolving field, 4-pole type alternator directly coupled to the flywheel of a conventional 4-cylinder gasoline engine. A separate exciter is mounted in tandem with the alternator. Included in the unit are all controls and instruments necessary to operate and regulate the equipment, and a winterization system designed to facilitate starting the unit in extremely low temperatures. The entire unit is mounted within a welded tubular frame structure. The generator is rated at 12.5 kw (kilowatt), .8 power factor, 3-phase, 60 cycles at 1,800 rpm (revolutions per minute).

The following output combinations are obtainable:

a. 120-volt a-c (alternating current), 3-phase, 3-wire, 60 cycles.

b. 240-volt a-c, 3-phase, 3-wire, 60 cycles.

c. 120/208-volt a-c, 3-phase, 4-wire, 60 cycles.

d. 240/416-volt a-c, 3-phase, 4-wire, 60 cycles.

Note. The generator is also capable of 10-kw, single-phase operation with the following output combinations: 120-volt a-c, single-phase, 2-wire, 60 cycles, or 240-volt a-c, single-phase, 2-wire, 60 cycles.

4. Application

Power Unit PU–26A/U is intended primarily as a source of power for the operation of Radar Sets AN/CPS–1, AN/CPS–6, AN/FPC–1, AN/FPC–2, AN/MPG–1, AN/MPQ–10, and AN/MPQ–10A and Radio Set SCR–615–B. The equipment may be used as a source of power for the operation of any other equipment that requires power within the rated capacity of the unit.

5. Major Parts and Assemblies

Note. All left and right designations are assumed from the point of an observer standing at the radiator end, facing the unit.

a. Engine. The unit is powered by an automotive-type Willys No. 807532, L-head, 4-stroke cycle, 4-cylinder, liquid-cooled, gasoline engine. Developing 35 horsepower at 1,800 rpm, the engine has a bore of 3⅛ inches, a stroke of 4⅜ inches, and a piston displacement of 134.2 cubic inches. The engine operates on fuel conforming to specification MIL–G–3056 and oil conforming to specification MIL–O–2104.

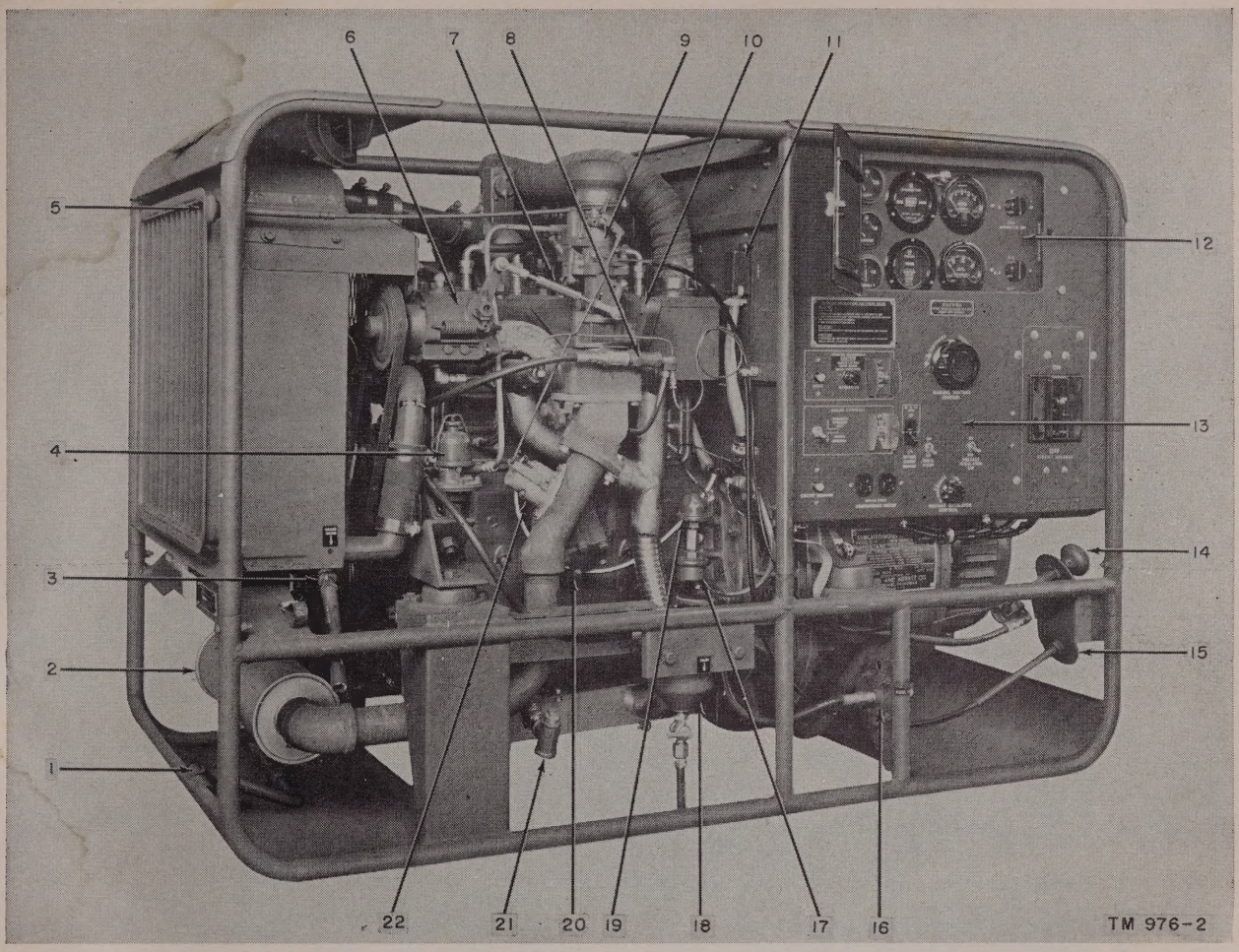
b. Fuel System. The major components of the fuel system include a disk-type fuel filter (18, fig. 2), a reciprocating-diaphragm fuel pump (4, fig. 2) with a lever for manual operation, a downdraft carburetor (9, fig. 2) with adjustable idling and altitude jets, an oil-bath air cleaner (8, fig. 3), and an automatic electric choke (22, fig. 2). Also provided are a manual CHOKE (5, fig. 2) and a PRIMING PUMP (14, fig. 2). A manually operated THROTTLE (15, fig. 2) is provided for overriding the governor to permit operation of the engine at idling speeds. An auxiliary fuel line, furnished with the unit, is used to supply operational fuel from an external source. (The power unit is not equipped with an integral fuel tank.)

c. Cooling System (fig. 3). The cooling system consists essentially of a standard tubular-cell radiator (14), and engine-driven water pump, a pusher-type fan, a bypass thermostat, and an adjustable coolant temperature cutoff switch (11). The switch is set at the factory to open the ignition circuit (thereby stopping the engine) when the coolant temperature exceeds 200°F. The capacity of the cooling system is 16 quarts.

d. Lubrication System. Circulation of the engine lubricating oil is provided by a gear-type oil pump (20, fig. 2) driven from a spiral gear on the camshaft. An oil filter (13, fig. 3) is mounted on the left side of the engine. A bayonet-type gage, in the oil filler tube (12, fig. 3), is provided to permit checking the oil level in the engine crankcase. Capacity of the crankcase is 4 quarts. A low-oil-pressure cutoff switch (17, fig. 2) opens the ignition circuit and stops the engine whenever the oil pressure drops below 5 psi (pounds per square inch).

e. Ignition System. The 6-volt ignition system derives its current through a dropping resistor (9, fig. 5) from two externally located, series connected, 6-volt batteries. An igniter assembly (10, fig. 3), mounted on the left side of the engine, consists of a camshaft-driven distributor, a capacitor, and an ignition coil. The spark plugs and ignition cables are suitably waterproofed and shielded to prevent radio-frequency radiation. An EMERGENCY OPERATION-NORMAL OPERATION switch (3, fig. 11) is located on the control panel.

f. Starting System. A 12-volt d-c (direct-current) starting motor (9, fig. 3), mounted on the left side of the engine, is energized by two 6-volt batteries connected in series. The starting system also includes a start relay (8, fig. 5), hold relay (6, fig. 5), and a battery-charging relay (7, fig. 5). A START-STOP switch (2, fig. 11) is located on the control panel. The batteries are charged by means of a dry-disk selenium rectifier (5, fig. 5) and a transformer (2, fig. 4). The battery-charging system is protected by a circuit breaker (22, fig. 11). A hand crank (1, fig. 2) for manual starting is mounted on the front skid in the lower frame. Facilities



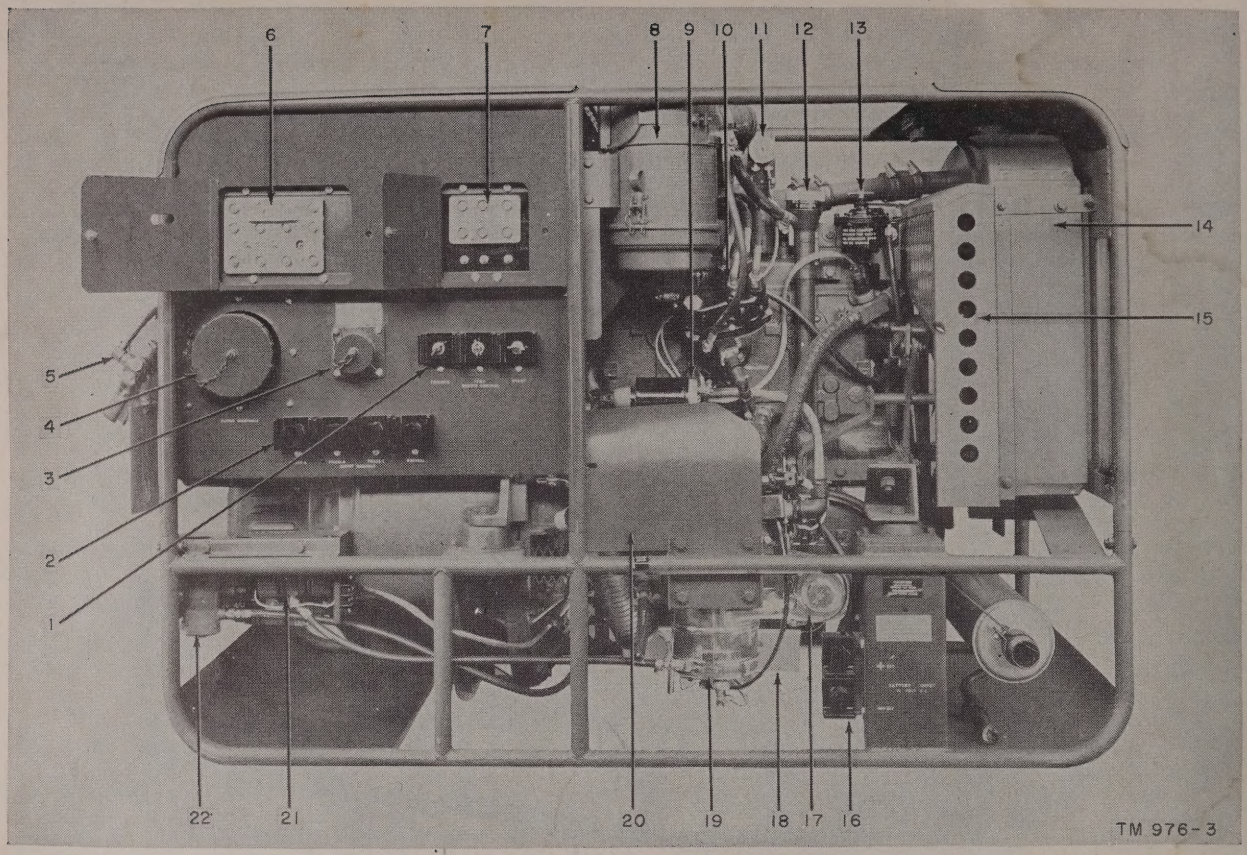
1 Hand crank (A 113)
2 Muffler (A 45)
3 Radiator drain valve (H114)
4 Fuel pump (O 86)
5 Manual CHOKE (O 142)
6 Engine-speed governor (O 95)
7 Carburetor-to-governor linkage (O 112)
8 Ventilating control valve (H496)
9 Carburetor (O 51)
10 Engine overspeed safety governor (O 109)
11 Ten-conductor socket (J4)
12 Instrument panel (A 71)
13 Control panel
14 PRIMING PUMP (O 85)
15 Manual THROTTLE (O 141)
16 Auxiliary fuel line adapter plate (A 28)
17 Low-oil-pressure cutoff switch (S2)
18 Fuel filter (O 83)
19 Oil-pressure transmitter (E8)
20 Oil pump (O 132)
21 Crankcase drain (H534)
22 Automatic choke (L2)

Figure 2. Power Unit PU–26A/U, right view.

are provided for starting and stopping the unit from a remote station. Packaged with the unit are the following cables: one 6-foot cable for connecting the batteries to the start solenoid terminal (located on the lower frame on the left side of the unit), one 6-foot cable for connecting the batteries to ground, and one short cable for the battery-to-battery connection.

g. Exhaust System (fig. 2). The engine exhaust is carried by rigid pipe to the muffler (2) located laterally across the front of the unit below the radiator. A flexible exhaust extension tube, 10 feet long, equipped with adapters for ease in attachment to the muffler, is provided.

h. Winterization System (fig. 3). To facilitate starting the equipment in extremely cold temperatures and to keep the equipment in a stand-by condition, a winterization system is incorporated within the unit. Major components of the system include a heater (19), a blower motor (17), an electric fuel pump (22), a fuel control valve (21), a heat ex-



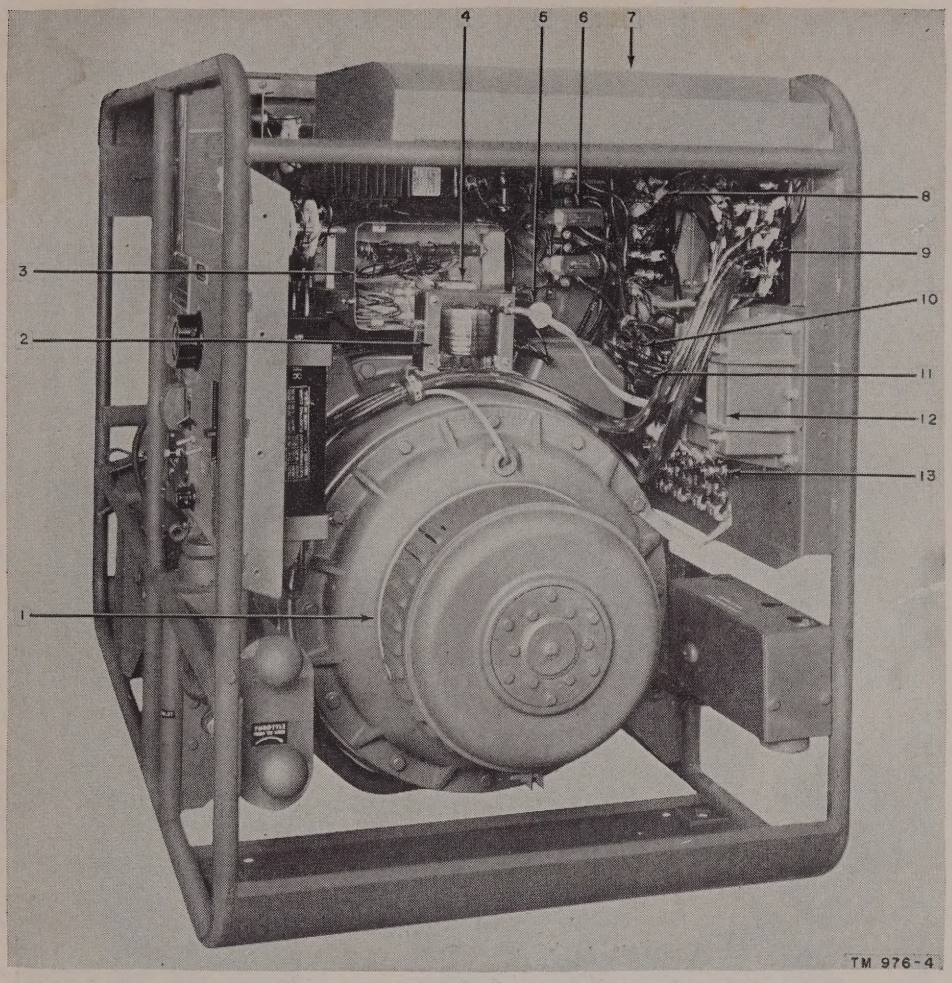
1 Remote control terminals (TB19 through TB21)
2 Output terminals (E16 through E19)
3 Three-pole output receptacle (J3)
4 Four-pole output receptacle (J2)
5 Fire extinguisher (O 149)
6 Series-parallel change board (TB1)
7 Wye-delta change board (TB2)
8 Air cleaner (O 2)
9 Starting motor (B1)
10 Igniter assembly (E1)
11 High-coolant-temperature cutoff switch (S3)
12 Oil filler tube (A 54)
13 Oil filter (O 126)
14 Radiator (A 10)
15 Fan guard (A 12)
16 Battery input terminals (E10, E11)
17 Heater blower motor (B2)
18 Heat exchanger pan (A 128)
19 Heater (O 153)
20 Heater shield (A 106)
21 Heater fuel control valve (L3)
22 Heater fuel pump (L4)

Figure 3. Power Unit PU–26A/U, left view.

changer pan (18), and metal air ducts. Controls for operating this system are incorporated on the control panel (fig. 11).

i. Instrument Panel (fig. 11). The instrument panel is shock-mounted on the right side of the unit and is accessible through a hinged door. Located on the instrument panel are an ammeter (13), an ammeter selector switch (14), a voltmeter (15), a voltmeter selector switch (16), a frequency meter (8), a running time meter (11), and a panel lamp (12). Engine instruments include an oil pressure gagé (9), a battery-charging ammeter (7), and a coolant temperature gage (10).

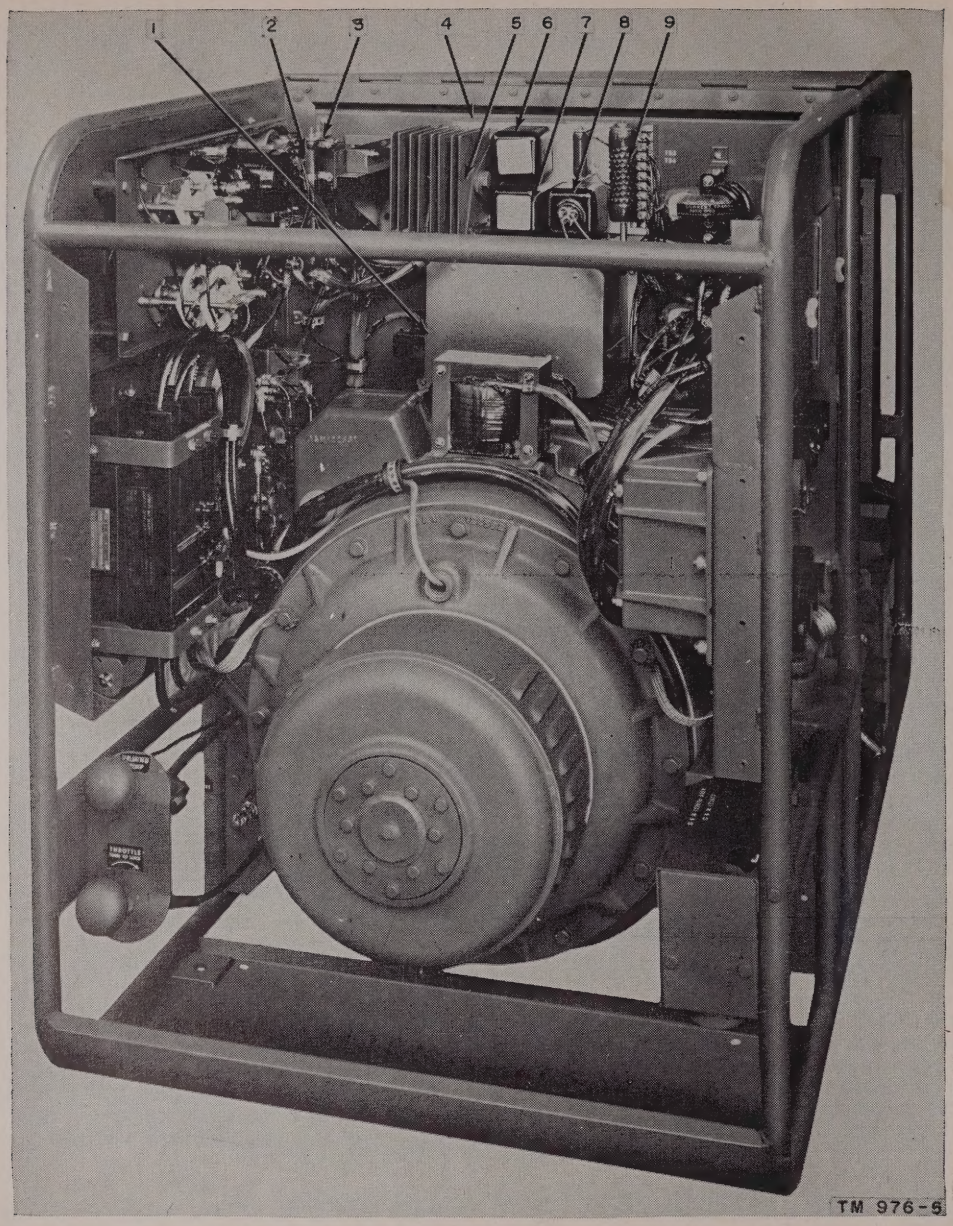
j. Control Panel (fig. 11). Located below the instrument panel are the controls necessary to operate the unit. These controls include toggle switches for starting the equipment, two circuit breakers (1, 18), a MANUAL VOLTAGE CONTROL rheostat (17), a VOLTAGE REGULATOR CONTROL rheostat (20), and a VOLTAGE REGULATOR SW ON-OFF switch (19). Controls for the winterization system include a toggle switch (4) for starting the heater, an indicator lamp (5), and a circuit breaker (6). The panel also includes a PANEL LIGHT ON-OFF switch (21), a BATTERY CHARGE BREAKER (22), and a CONVENIENCE OUTLET receptacle (23).



1 Generator (G1)
2 Battery-charging transformer (T2)
3 Voltage regulator box (VR1)
4 Voltage regulator (VR2)
5 Voltmeter-dropping resistor (R20)
6 Ammeter current transformers (T3 through T5)
7 Tool trays (A 99, A 101)
8 Wye-delta change board (TB2)
9 Series-parallel change board (TB1)
10 Remote control terminals (E12 through E14)
11 Three-pole output receptacle (J3)
12 Four-pole output receptacle (J2)
13 Output terminals (E16 through E19)

Figure 4. Power Unit PU–26A/U, right rear view.

k. Generator. The generator (1, fig. 4) consists of a revolving field alternator and a built-in exciter. Both the alternator and exciter are located within the same housing. The revolving field of the alternator and the armature of the exciter are mounted on the same shaft and make up the rotor. The rotor is direct-connected to the engine flywheel and is supported at the outboard end by a single ball bearing. The stator (alternator armature) consists of six 120-volt windings which terminate at the series-parallel change board (6, fig. 3). The three phases are then connected to the wye-delta change board (7, fig. 3). The generator is rated at 12.5 kw, .8 power factor, 3-phase, 60 cycles at 1,800 rpm. (Refer to par. 14*a* for voltage output combinations.) Voltage regulation of the generator output is automatically controlled by a voltage regulator (4, fig. 4) and, for manual control in an emergency, by a hand rheostat (17, fig. 11). The wye-delta change board, the series-parallel board, two power output receptacles (3, 4, fig. 3), and four output terminals (2, fig. 3), are located on the left side of the unit.



1 Voltage regulator box (VR1)
2 Voltage regulator control variable resistor (R18)
3 Manual voltage control resistor (R17)
4 Remote starting control chassis (A 83)
5 Battery-charging selenium rectifier (CR2)
6 Hold relay (K3)
7 Battery-charging relay (K2)
8 Start relay (K1)
9 Ignition-dropping resistor (R1)

Figure 5. Power Unit PU–26A/U, left rear view.

l. Radio-Frequency Suppression Equipment. Radio frequencies produced by the operation of the unit are suppressed by shielding, grounded connecting straps, grounded capacitors, resistor-suppressors, and bonds formed by external-internal-toothed lockwashers. A complete description of all suppression equipment is discussed in paragraph 65.

m. Frame. The entire power unit is assembled within a tubular frame structure comprised of two parts. The lower frame forms a skid and also shock-mounts the engine and generator. The upper frame mounts the instrument and control panels. A canvas cover is supplied to protect the complete unit during stand-by periods and storage.

6. Performance Characteristics

a. 120-Volt, 3-Phase, .8 Power Factor (Parallel-Delta Connection).

Approximate load	Amperes	Output volts	Kilowatts	Cycles	Exciter volts
0	0	122.0	0	61.2	30
¼	18.6	121.5	3.125	60.9	37
½	37.2	121.0	6.25	60.6	44
¾	56	120.5	9.375	60.3	54
Full	75	120	12.5	60.0	65

b. 240-Volt, 3-Phase, .8 Power Factor (Series-Delta Connection).

Approximate load	Amperes	Output volts	Kilowatts	Cycles	Exciter volts
0	0	244	0	61.2	30
¼	9.3	243	3.125	60.9	37
½	18.6	242	6.25	60.6	44
¾	28	241	9.375	60.3	54
Full	37.5	240	12.5	60	65

c. 120/208-Volt, 3-Phase, .8 Power Factor (Parallel-Wye Connection).

Approximate load	Amperes	Output volts	Kilowatts	Cycles	Exciter volts
0	0	211	0	61.2	30
¼	10.6	210	3.125	60.9	37
½	21.4	209	6.25	60.6	44
¾	32.4	208.5	9.375	60.3	54
Full	43.5	208	12.5	60	65

d. 240/416-Volt, 3-Phase, .8 Power Factor (Series-Wye Connection).

Approximate load	Amperes	Output volts	Kilowatts	Cycles	Exciter volts
0	0.	422	0	61.2	30
¼	5.3	420	3.125	60.9	37
½	10.7	418	6.25	60.6	44
¾	16.2	417	9.375	60.3	54
Full	21.75	416	12.5	60	65

7. Condensed Tables of Specifications

a. Engine.

Make—Willys-Overland.
Model—No. 807532.
Type—4-stroke cycle.
Type cylinder head—L.
Number of cylinders—4.
Bore—3⅛ in.
Stroke—4⅜ in.
Piston displacement—134.2 cu in.
Compression ratio—6.48 to 1.
Firing order—1–3–4–2.
Speed—1,800 rpm.
Horsepower—35 at 1,800 rpm.
Type cooling—Liquid.
Cooling system capacity—16 qt.
Type lubrication—Pressure and splash system.
Oil capacity—4 qt.
Fuel consumption—2.2 gallons per hour.
Air cleaner—Oil-bath type.
Spark plugs—14 mm; integrally shielded and suppressed.
Ignition system—Sealed distributor.
Batteries—6 v each.

b. Alternator.

Make—O'Keefe and Merritt.
Model—SF–15.
Type—4-pole, revolving field.
Voltage—120 v a-c (parallel-delta connection).
240 v a-c (series-delta connection).
120/208 v a-c (parallel-wye connection).
240/416 v a-c (series-wye connection).

Phase——3-phase, 3-wire (delta connection).
3-phase, 4-wire (wye connection).
Cycle——60.
Power factor——0.8.
Ampere rating——75 amperes (parallel-delta connection).
37.5 amperes (series-delta connection).
43.5 amperes (parallel-wye connection).
21.75 amperes (series-wye connection).
Kilowatt rating——12.5.
Speed——1,800 rpm.
Drive——Direct.

c. Exciter.

Make——O'Keefe and Merritt.
Type——4-pole, shunt field.
Voltage——65.
Ampere rating——6.
Speed——1,800 rpm.
Drive——Direct.

8. Tabular Data

a. Weights and Dimensions. The table of weights and dimensions of Power Unit PU–26A/U follows:

a. Weights and Dimensions.

Quantity	Item	Dimensions				
		Width (in.)	Length (in.)	Height (in.)	Volume (cu ft)	Weight (lb)
1	Power Unit PU-26A/U.	28	54	37	32.4	1,250
1	Engine	24	26	30	10.8	405
1	Generator	25.13	22.25	21.75	7.1	410.75
2	Batteries (crated), each.	10.25	15	12	1.07	50

b. Spare Parts. The spare parts listed below are wrapped individually in moistureproof and fungiproof paper. They are packed in the spare parts tray within the unit.

Quantity	Item
1	Belt, drive, engine fan.
1	Belt, drive, engine speed governor.
1	Capacitor, distributor.
2	Gaskets, oil filter bowl.
4	Gaskets, fuel filter cover.
4	Gaskets, fuel filter element.
4	Gaskets, fuel pump bowl.
1	Electrode, heater.
4	Spark plugs.
1	Lamp, panel.
1	Lamp, heater operating.

c. Tools. The tools listed below are oiled, wrapped separately in moistureproof and fungiproof paper, and packed in the tool tray within the unit.

Quantity	Item
1	Burnisher, ignition contact points.
1	Gage, spark plug and ignition contact points.
1	Hammer, ball peen.
1	Handle, wrench.
1	Bar, sliding, for wrench handle.
1	Oiler, hand.
1	Pliers, combination.
2	Sandpaper, flint.
1	Screw driver, ¼ in. blade.
1	Screw driver, ⅛ in. blade.
1	Screw, eye, generator lifting.
1	Wrench, adjustable.
1	Wrench, box and open end, ⅜ in.
1	Wrench, box and open end, $\frac{7}{16}$ in.
1	Wrench, box and open end, ½ in.
1	Wrench, box and open end, $\frac{9}{16}$ in.
1	Wrench, box and open end, $\frac{11}{16}$ in.
1	Wrench, socket, $\frac{11}{16}$ in.
1	Wrench, socket, spark plug, $\frac{13}{16}$ in.
1	Wrench, nut driver, $\frac{7}{16}$ in.

d. Installation Equipment. The following installation equipment is packaged individually and supplied with the unit.

Quantity	Item
1	Adapter, fuel drum.
1	Cable, battery, negative.
1	Cable, battery, positive.
1	Cable, battery-to-battery.
1	Connector, exhaust tubing pipe.
1	Coupling, exhaust tubing lock.
1	Hose, auxiliary fuel line.
1	Tube, flexible exhaust extension.

e. Miscellaneous Equipment. The following miscellaneous equipment is supplied with the unit:

Quantity	Item
2	Batteries, 6-volt storage.
1	Bracket, mounting, fire extinguisher.
1	Cover, canvas.
1	Crank, hand.
1	Fire extinguisher.
2	Technical Manuals, TM 11–976A, for Power Unit PU–26A/U.

CHAPTER 2
OPERATING INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF EQUIPMENT

9. Siting

Consider the following factors when selecting a site for the installation and operation of Power Unit PU–26A/U.

a. Relation to Load. Locate the power unit as near as possible to the electrical load. Excessively long cables from the unit to the load increase line resistance and cause a definite voltage drop and poor regulation.

b. Outdoor Installation. When the unit is to be operated outdoors, select a site that is reasonably dry and solid enough to support the weight of the unit (1,250 lbs.). No special foundation is necessary; however, the unit should be operated in as near a level position as possible. If the terrain is soft, muddy, or snow-covered, make a foundation out of planks or other similar material. (The base of the packing crate will serve as a temporary foundation under these conditions.) Provide some form of shelter to protect the equipment from the elements.

Note. If it is impossible to locate the unit on level ground, see that the generator end of the unit is the lower end. Do not operate the unit in a position that is more than 10° off level, longitudinally or laterally.

c. Indoor Installation. When the equipment is to be operated within a building or inclosure, set the unit so that the radiator is facing a door, window, or other opening through which the hot-air blast from the engine may pass outdoors. The air flows *out* from the radiator. If possible, attach a canvas duct to the radiator grill and attach the other end of the duct to the building opening (par. 12*d*). Connect the flexible exhaust tubing to the muffler outlet and extend the free end of the exhaust tubing to the outside of the building or shelter (par. 12*b*). Make sure that all exhaust connections are gastight. *Carbon monoxide fumes from a gasoline engine are extremely dangerous and, when inhaled, may cause serious illness or death.* Provide not less than 2 feet of space on all sides of the unit to facilitate working on and operating the equipment.

d. Location of Fuel Supply. If the unit is to be operated indoors, locate the fuel supply tank outside the inclosure within easy range of the 20-foot fuel line furnished with the equipment. Do not locate the tank more than 6 feet below the level of the engine fuel pump.

10. Preparation of Foundation

No special foundation is necessary. Refer to paragraph 9*b* for general information concerning outdoor installation.

11. Uncrating, Unpacking, and Checking

Power Unit PU–26A/U is shipped in three packages. The unit, including all spare parts, tools, installation equipment, and miscellaneous equipment, is contained in one large crate. The two batteries are packed in two separate boxes.

Note. The bottom of the unit crate is constructed to form a skid and can be used for sliding the unit short distances.

a. Uncrating and Unpacking. Before uncrating and unpacking, locate the unit near the site at which it will be operated. To avoid damage, uncrate the unit with care. Use a nail puller and other appropriate tools. Be sure to remove all packages and parts within the crate or they may be accidentally discarded with the packing material. When prepared for oversea shipment, the unit is inclosed in waterproof paper and a vaporproof barrier. When prepared for domes-

tic shipment, the vaporproof barrier is not used. Uncrate and unpack the equipment as follows:

(1) Remove the top and sides of the large crate.

(2) Remove the technical manuals located on top of the unit.

(3) Remove the waterproof paper and the vaporproof barrier, sealed around the bottom of the unit.

(4) Remove the canvas cover inclosing the entire unit.

(5) Remove all the packaged installation equipment located in the bottom of the lower frame.

(6) Remove the nuts from the four bolts securing the unit to the base of the crate. The power unit now can be moved.

(7) Unpack the spare parts and tools (packaged individually in the tool tray in the rear of the unit) only as required.

(8) Do not uncrate the batteries until the unit has been set up for operation.

b. Checking. A list of all spare parts and tools packed with the equipment is mounted on the under side of the tool tray cover. Be sure the equipment is complete and has not been damaged in shipment and handling.

(1) Check the tools, spare parts, installation equipment, and miscellaneous equipment with the packing list.

(2) Inspect the overall unit carefully for damage. Give particular attention to the following: Examine the carburetor, igniter assembly, air cleaner, and fuel pump for dents and breakage; check the fuel line from the fuel pump to the carburetor for loose connections and kinks; examine the instruments and controls for damage; and check all wiring for torn insulation and broken wires. If any damage is noted or the equipment does not check with the packing lists, fill out and forward DD Form 6 (Report of Damaged or Improper Shipment) in accordance with instructions in paragraph 2.

12. Setting up Equipment

After a suitable location has been chosen (par. 9) and the equipment has been checked (par. 11*b*), set up the unit for operation as follows:

a. Mounting on Foundation. When preparing the equipment for permanent indoor installation, bolt the unit solidly to the floor. Four holes are located in the mounting pads on the bottom four corners of the lower frame. Mount the unit to the floor with ½-inch bolts or lag screws of required length. For outdoor installation, locate the unit on level ground. If this is impossible, the generator end of the unit must be the lower end. Never operate the power unit in a position more than 10° off level, longitudinally or laterally.

b. Connecting Exhaust Tube. For indoor operation, connect the exhaust extension tube to the muffler (fig. 6). Extend the tube to an exterior wall; use the most direct route with as few bends as possible. *All connections must be gastight.* Pitch the tube downward, away from the unit, so that all resulting condensation will drain out. If the tubing passes through an inflammable wall, install appropriate fireproof insulation.

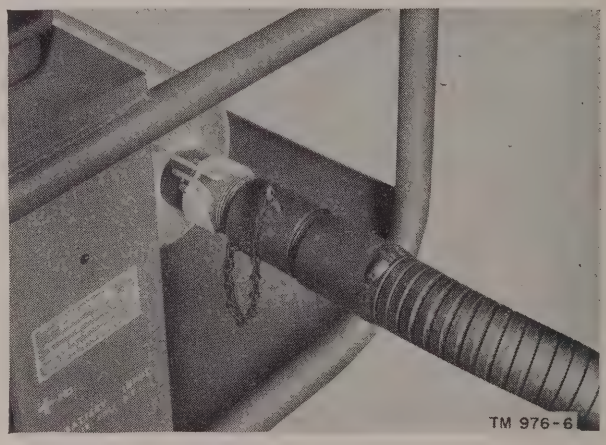


Figure 6. Exhaust tube connection to muffler.

Warning: Carbon monoxide is deadly poisonous. Inhaling exhaust gases may be fatal.

c. Connecting Fuel Hose. Connect the 20-foot fuel hose to the coupling assembly located near the fuel filter on the right side of the unit (fig. 7). Connect the opposite end to the fuel drum adapter. Mount the adapter in an externally

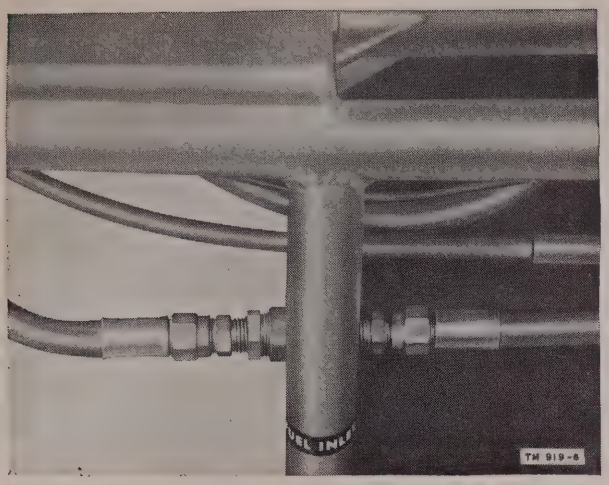


Figure 7. Fuel supply hose connection.

located fuel container. Be sure all connections are tight.

d. Installing Radiator Duct. The radiator grill is constructed with a channel flange around the outside edge. For indoor operation, attach a canvas duct to the flange. Use a window or make an opening in an exterior wall and attach the outlet end of the duct to permit exhausting the hot blast of air caused by engine operation. The opening must be at least as large as the radiator grill flange.

e. Installing Fire Extinguisher. The fire extinguisher, mounting bracket, and hardware are shipped loose with the equipment. Mounting holes have been drilled in the rear upper frame panel for mounting the fire-extinguisher bracket. Bolt the bracket to the unit and mount the fire extinguisher in the bracket.

Note. The fire extinguisher and mounting bracket can be mounted in any suitable place off the unit.

13. Removal of Corrosive Preventives

Corrosion preventives are for permanent protection and must not be removed. There are no protective seals installed on the unit.

14. Connections and Interconnections

All internal connections for the operation of the power unit are made at the factory and no additional connections within the unit are needed. Make power output connections, remote start connections, and battery connections as follows:

a. Power Output Connections (fig. 8). The Y-△ CHANGE BOARD, SERIES-PARALLEL CHANGE BOARD, and power output terminals and receptacles are located on the left side of the unit. Check the output rating in which the unit is connected by sighting through the windows in the doors of the change boards. The wye-delta board is marked Y (wye) and △ (delta); the series-parallel board is marked SERIES and PARALLEL. To change the voltage connections, remove the nuts and washers that are used to secure the jumper boards to the terminal board. (Use the nut driver supplied with the unit to remove the nuts.) Then proceed as follows:

(1) For 120-volt, 3-phase operation, connect the jumper boards in the △ (delta) and PARALLEL positions. Connect the cables from the load to the output terminals marked PHASE-A, PHASE-B, and PHASE-C. Use cable not smaller than No. 4 AWG (American wire gauge). Set the ON-OFF CIRCUIT BREAKER as instructed in paragraph 18*b*(1).

(2) For 240-volt, 3-phase operation, connect the jumper boards in the △ (delta) and SERIES positions. Connect the cables from the load to the output terminals marked PHASE-A, PHASE-B, and PHASE-C. Use cable not smaller than No. 6 AWG. Set the ON-OFF CIRCUIT BREAKER as instructed in paragraph 18*b*(1).

(3) For 120/208-volt, 3-phase operation, connect the jumper boards in the Y (wye) and PARALLEL positions. Connect the cables from the load to the output terminals marked PHASE-A, PHASE-B, PHASE-C, and NEUTRAL (if required). Use cable not smaller than No. 6 AWG. Set the ON-OFF CIRCUIT BREAKER as instructed in paragraph 18*b*(1).

(4) For 240/416-volt, 3-phase operation, connect the jumper boards in the Y (wye) and SERIES positions. Connect the cables from the load to the output terminals marked PHASE-A, PHASE-B, PHASE-C, and NEU-

TRAL (if required). Use cable not smaller than No. 8 AWG. Set the ON-OFF CIRCUIT BREAKER as instructed in paragraph 18*b*(1).

Note. To obtain 120-volt, single-phase, 10-kw output, connect the jumper boards in the Δ (delta) and PARALLEL positions. Connect the cables from the load to the PHASE-A and PHASE-B terminals. For 240-volt, single-phase, 10-kw operation, connect the jumper boards in the Δ (delta) and SERIES positions. Connect the cables from the load to the PHASE-A PHASE-B terminals.

Warning: Never attempt to change the output rating or open the doors of the change boards while the unit is in operation.

(5) The small 3-pole power output receptacle, connected in parallel with the 3-phase output terminals, and the large 4-pole power OUTPUT RECEPTACLE, connected in parallel with the 3-phase and NEUTRAL terminals, can be used for output connections when the load hook-up contains a plug-in type receptacle. The poles of the receptacles on the unit are

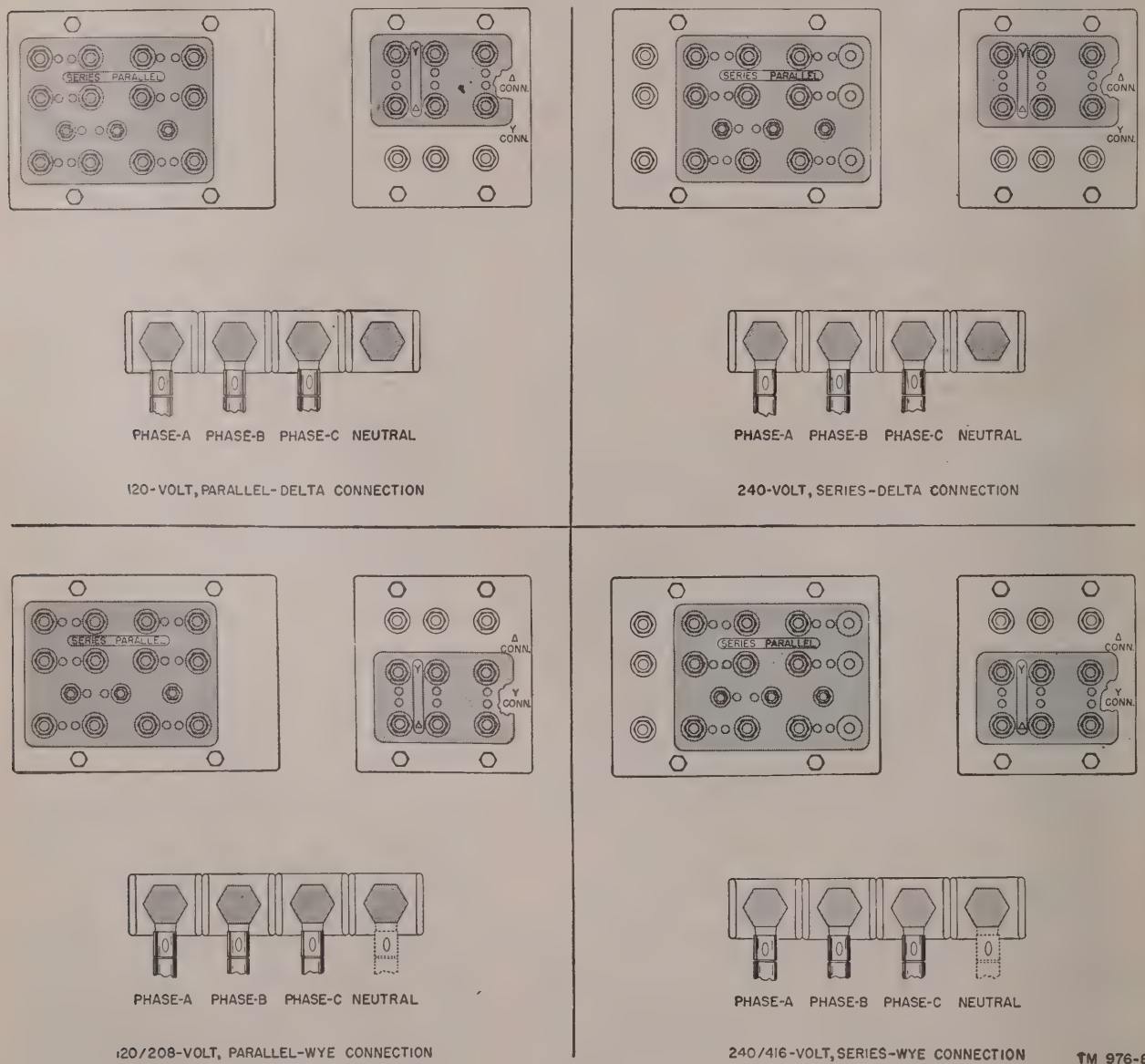


Figure 8. Power output connections.

lettered adequately and numbered for phase designations.

Caution: Never draw more than 50 amperes per leg through the small 3-pole output receptacle.

b. Remote Control Connections. Three remote control terminals are located on the left side of the unit, above and to the right of the output terminals. The terminals are marked COMMON, STOP and START. By using a 3-conductor cable, No. 14 AWG or larger, the remote location may be extended up to 140 feet. To operate the unit from a remote location, it is necessary to install a start-stop switch at the remote point. With a single-pole, double-throw, center-off toggle switch, make the following connections:

(1) Connect the cable from the stop terminal on the switch to the remote STOP terminal on the unit.

(2) Connect the cable from the start terminal on the switch to the remote START terminal on the unit.

(3) Connect the cable from the center terminal on the switch to the remote COMMON terminal on the unit.

c. Battery Connections. Two terminals for connecting the battery cables are located on the left side of the unit. After preparing the batteries for use (par. 17), position the batteries near the unit and connect them in series as follows: Attach the battery jumper cable from the negative post of one battery to the positive post of the other battery. Connect a cable from the positive (+) terminal on the unit to the battery with the *open* positive post. Connect a cable from the negative (—) terminal on the unit to the battery with the *open* negative post. Figure 9 shows the proper battery connections.

15. Initial Lubrication

Make sure that the crankcase oil drain valve is closed. Remove the cap on the oil-filler tube and fill the crankcase with oil as specified in the lubrication chart (fig. 17). The capacity of the lubrication system is 4 quarts. Unfasten the two clamps on the air cleaner and remove the bowl. Clean the bowl with Solvent, Dry Cleaning (SD) and fill it to the normal oil level mark with oil as specified in the lubrication chart. The remainder of the unit is factory-lubricated and does not require initial preparation.

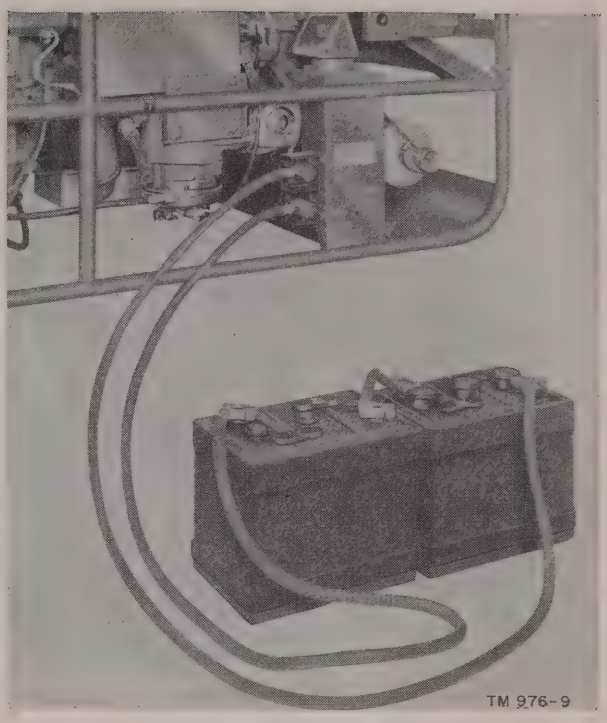


Figure 9. Battery connections.

16. Preparation of Fuel System and Cooling System

a. Connect the fuel supply to the unit as instructed in paragraph 12*c*. Manually crank the engine a few times to make sure that all parts move freely. Operate the hand lever on the fuel pump (fig. 10) to see if it operates freely. If the fuel pump hand lever cannot be moved, crank the engine one complete revolution. If the engine camshaft is in a position where the fuel pump arm is held up by the cam, the fuel pump hand lever cannot be operated. When the fuel pump hand lever can be moved freely, move it up and down until pressure built up within the fuel system prevents further operation of the hand lever. Now push the hand lever down and leave it there. The fuel pump will not operate unless this lever is in the down position. Set the air-inlet gage on the air cleaner at the correct position for the temperature in which the unit is to be operated (above 50°F. or below 50°F.).

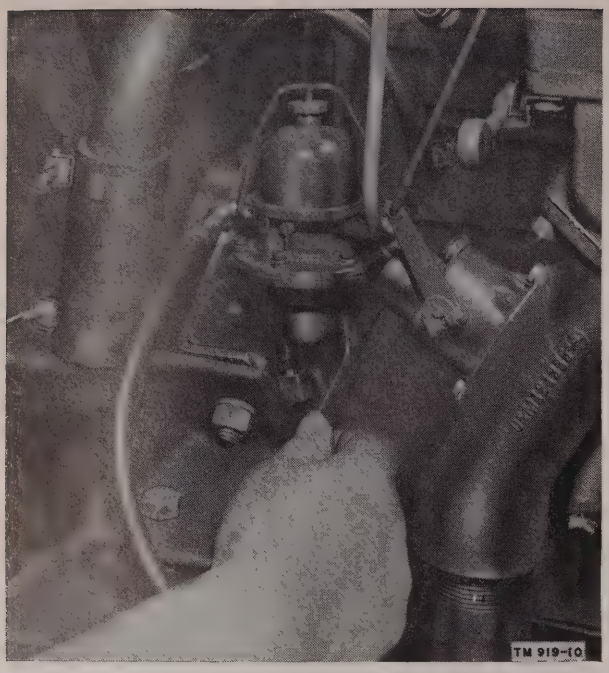


Figure 10. Priming fuel pump.

b. Check the coolant drain cocks on the radiator and on the winterization heater. They must be closed. Fill the cooling system with clean water for use in temperatures above 32°F. In temperatures of 32°F. or lower, add antifreeze in accordance with current directives. The liquid capacity of the cooling system is 16 quarts.

17. Preparation of Storage Batteries

a. Initial Preparation. The two 6-volt, lead-acid storage batteries are shipped in a dry-charged condition. The manufacturer's instructions for preparing the batteries are lettered on each battery. Additional instructions follow:

(1) Remove or destroy any sealing device which may have been used to close or restrict the vent openings.

(2) Fill the battery cells to one-half inch above the top of the separators with electrolyte having a specific gravity of 1.280 at a temperature of 80°F. Prepare the electrolyte as follows: Use a heat resistant glass or earthenware or a lead container. Place a quantity of distilled water or rain water that has been caught in a non-metallic container in the mixing vessel. Pour electrolyte with a specific gravity of 1.400 or 1.835 slowly into the water. *Never pour the water into the acid.* Stir the mixture gently but thoroughly while mixing. Test the solution with a hydrometer while mixing to avoid adding too much acid to the water. When the solution has reached a specific gravity of 1.280, allow it to cool to a temperature of 80°F. and again test the specific gravity. If the specific gravity, at 80°F., does not test 1.280, add more acid until the correct specific gravity is indicated.

Caution: When handling sulfuric acid, avoid getting any of the acid or electrolyte solution in contact with parts of the body. Keep hands away from eyes and mouth. Rubber gloves should be worn while working around sulfuric acid and storage batteries. If the acid should come in contact with parts of the body, flush immediately with plenty of clean water.

(3) Allow the batteries to stand from 1 to 4 hours and then inspect the level of the electrolyte in the battery cells. If the level of the electrolyte has dropped below the tops of the separators, add electrolyte to correct the level.

b. Charging Procedure. If possible, give the batteries a freshening charge as follows: Charge the battery at 8 amperes at an electrolyte temperature of 80°F. Charge until three consecutive readings of voltage and/or specific gravity at ½-hour intervals show no increase. During the charging period, the temperature of the electrolyte should not exceed 110°F. The following table gives the specific gravity values for batteries in various states of charge. All the values shown are for electrolyte at the correct filling height and at 80°F.

Approximate state of charge	Standard specific gravity in temperate climates
Fully charged	1.280
75% charged	1.250
50% charged	1.220
25% charged	1.190
Discharged	1.150

c. Temperature Changes of Specific Gravity.

(1) The hydrometer readings will be correct only when the electrolyte in the battery is at a temperature of 80°F. If the temperature is higher or lower than 80°F., an allowance must be made to correct the reading obtained.

(2) Draw electrolyte in and out of the hydrometer barrel several times to bring the temperature of the hydrometer float to that of the acid in the cell and then measure the electrolyte temperature in the cell. Some hydrometers have a small thermometer and a correction scale built into them so that the temperature corrections can be made readily. The temperature correction is approximately .004 specific gravity (sometimes referred to as four points of gravity) for each 10°F. change in temperature.

(3) The following table shows the correction for hydrometer readings with the amount to be added or subtracted when the electrolyte temperature (not the air temperature) is above or below 80°F.

Temperature of electrolyte (°F)	Specific gravity correction factor
160	Add .032
155	Add .030
150	Add .028
145	Add .026
140	Add .024
135	Add .022
130	Add .020
125	Add .018
120	Add .016
115	Add .014
110	Add .012
105	Add .010
100	Add .008
95	Add .006
90	Add .004
85	Add .002
80	.000
75	Subtract .002
70	Subtract .004
65	Subtract .006
60	Subtract .008
55	Subtract .010
50	Subtract .012
45	Subtract .014
40	Subtract .016
35	Subtract .018
30	Subtract .020
25	Subtract .022
20	Subtract .024
15	Subtract .026
10	Subtract .028

Section II. CONTROLS AND INSTRUMENTS

Note. This section describes, locates, illustrates, and furnishes the operating personnel with information pertaining to the various controls and instruments provided for the proper operation of the equipment.

18. Manual Controls

a. Engine.

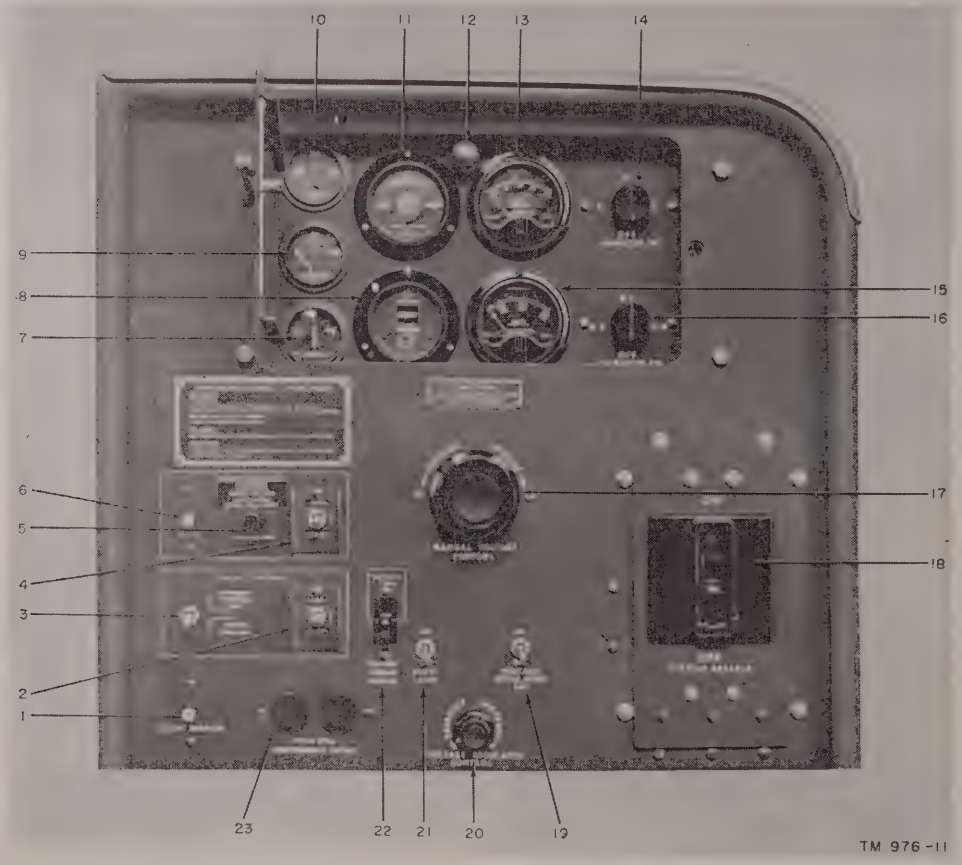
(1) *Ignition switch* (fig. 11). An EMERGENCY OPERATION-NORMAL OPERATION toggle switch (3), located on the control panel, is used to select the ignition circuit for normal (automatic) or emergency (manual) starting. If the unit is to be started by hand cranking, place the switch in the EMERGENCY OPERATION ONLY position; if the unit is to be started remotely or by means of the START-STOP switch ((2) below), place the switch in the NORMAL OPERATION position. Refer to paragraph 22 for complete instructions on starting the unit.

(2) *Start-stop switch* (fig. 11). The 3-position, momentary-contact START-STOP toggle switch (2) is located on the control panel. To start the unit, hold the switch in the START position; to stop the unit, momentarily hold the switch in the STOP position. The switch is designed so that the actuating handle returns to the OFF position (center) when released from the START or STOP position. Refer to paragraph 22 and 26 for complete instructions on starting and stopping the unit.

(3) *Choke* (fig. 2). To assist in starting the unit while hand cranking, a flexible wire-and-sleeve type manual CHOKE (5) is mounted on the right side of the radiator. Pull out the CHOKE when hand cranking a cold engine. After the unit has started, push in the CHOKE all the way.

Note. The function of the automatic choke (par. 19*a*(5)) is sufficient after the engine has started and manual choking is no longer necessary.

(4) *Throttle* (fig. 2). The manual THROTTLE (15) is a wire-and-sleeve type control mounted on the rear of the unit just below the control panel. Use the manual THROTTLE to run the engine for prolonged periods of no-load operation or when the unit is to be started in a cold temperature and it is necessary to warm up the engine at idling speed. To operate the manual THROTTLE, turn the knob counterclockwise and pull it out to decrease engine speed. Lock the THROTTLE in the desired position by turning the knob clockwise.



1 Convenience-outlet CIRCUIT BREAKER (CB2)
2 START—STOP switch (S4)
3 EMERGENCY OPERATION—NORMAL OPERATION switch (S1)
4 Heater START—RUN switch (S8)
5 Heater OPERATING indicator lamp (I 2)
6 Heater circuit breaker (RESET) (CB1)
7 Battery-charging ammeter (M3)
8 Frequency meter (M5)
9 Oil-pressure gage (M1)
10 Coolant-temperature gage (M2)
11 Running-time meter (M4)
12 Panel lamp (I 1)
13 Ammeter (M7)
14 Ammeter selector switch (AMMETER SW) (S11)
15 Voltmeter (M6)
16 Voltmeter selector switch (VOLTMETER SW) (S10)
17 MANUAL VOLTAGE CONTROL (R16)
18 ON-OFF CIRCUIT BREAKER (CB3)
19 VOLTAGE REGULATOR ON-OFF switch (SW) (S9)
20 VOLTAGE REGULATOR CONTROL (R19)
21 PANEL LIGHT ON-OFF switch (S5)
22 BATTERY CHARGE BREAKER (CB4)
23 CONVENIENCE OUTLET (J1)

Figure 11. Instrument and control panel.

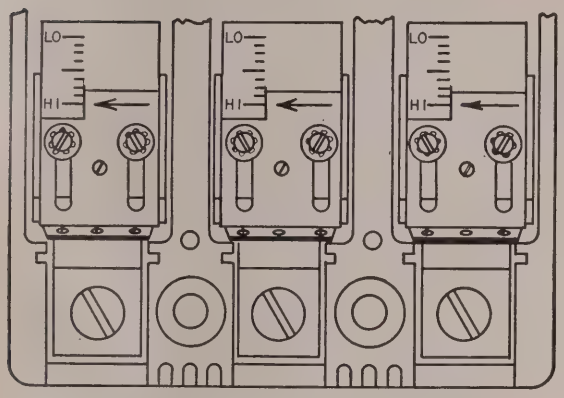
Caution: Do not apply load to the unit while the manual THROTTLE is in control.

(5) *Priming pump* (fig. 2). The unit is provided with a PRIMING PUMP (14) located just above the manual THROTTLE. Use the pump when starting the unit in low temperatures. To operate the pump, pull out the knob all the way and push it back to its original position. Operate the pump only while the engine is being cranked. One or two strokes are sufficient to start the engine. Be careful not to overprime it.

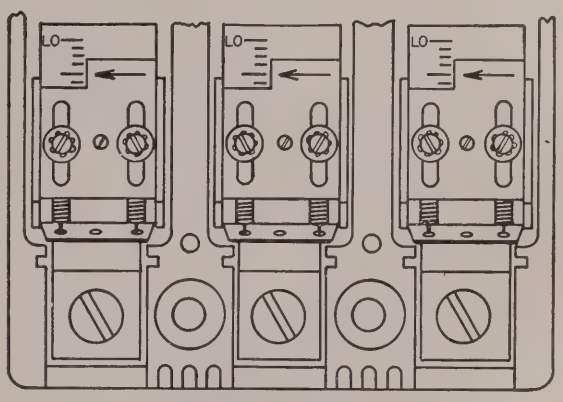
b. Generator.

(1) *Circuit breaker* (fig. 11). The ON-OFF CIRCUIT BREAKER (18), mounted on the control panel, serves as the main load ON–OFF switch and the overload trip in the a-c circuit. To connect the load, push the trip lever to ON; to disconnect the load, push the trip lever to OFF. The ON-OFF CIRCUIT BREAKER trips off automatically (par. 19*b*(1)) whenever the circuit becomes heavily overloaded. To reset the circuit breaker after it has tripped, push down the lever all the way past the OFF position, then up to the ON position. The load rating of the circuit breaker is adjustable to meet the requirements of the various output combinations. Refer to figure 12 for the correct setting.

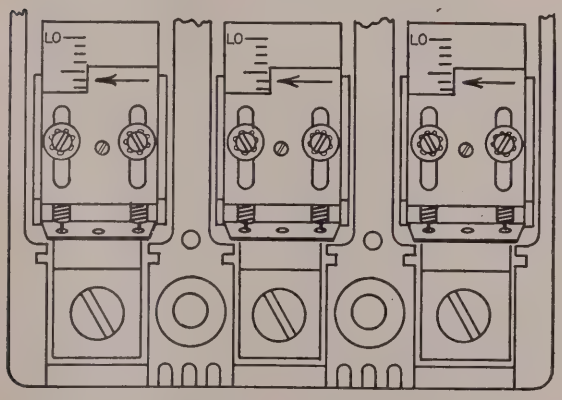
Caution: Whenever the output combination is changed, the ON-OFF CIRCUIT BREAKER *must* be re-



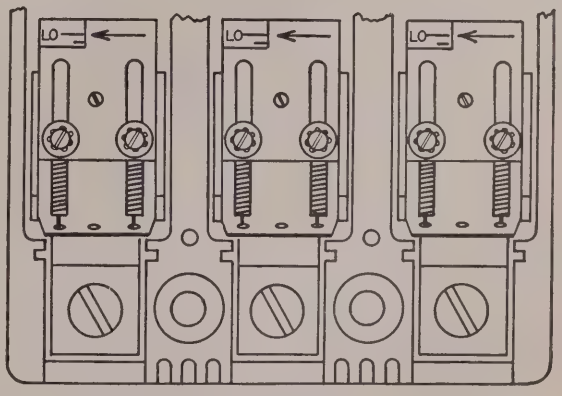
SETTING FOR PARALLEL-DELTA CONNECTION



SETTING FOR SERIES-DELTA CONNECTION



SETTING FOR PARALLEL-WYE CONNECTION



SETTING FOR SERIES-WYE CONNECTION

TM 976-12

Figure 12. Circuit breaker adjustments.

adjusted. Do *not* attempt adjustment while the unit is operating.

(2) *Voltage regulator control* (fig. 11). The VOLTAGE REGULATOR CONTROL (20) is used to set the desired output voltage. To operate the control after the unit is operating under load, place the VOLTAGE REGULATOR SW (switch) (19) in the ON position. Then turn the control knob (clockwise to increase the voltage; counterclockwise to decrease the voltage) until the desired reading on the voltmeter is maintained. Refer to paragraph 19*b*-(2) for a discussion of the automatic components of the voltage regulator.

(3) *Manual voltage control* (fig, 11). The MANUAL VOLTAGE CONTROL (17), a field rheostat-type control, is used during periods of emergency only. If the automatic voltage regulation system becomes inoperative, plate the VOLTAGE REGULATOR SW (switch) (19) in the OFF position. Then, with the unit operating under load, turn the MANUAL VOLTAGE CONTROL knob (clockwise to increase the voltage; counterclockwise to decrease the voltage) until the desired reading on the voltmeter is maintained. The MANUAL VOLTAGE CONTROL will maintain the desired voltage under stable load; however, changes in load will necessitate readjustment of the control.

(4) *Wye-delta change board and series-parallel change board* (fig. 3). The Y-△ CHANGE BOARD (7) and the SERIES-PARALLEL CHANGE BOARD (6), mounted on the left side of the unit, are used to select the output voltage of the generator, depending on the load requirements. Refer to paragraph 14*a* for instructions on changing the voltage connections by means of the change boards. The connections can be checked through a *window* provided in each change board door.

c. Winterization System (fig. 11). All the winterization system controls are located on the control panel.

(1) *Circuit breaker.* The circuit breaker (RESET) (6) is used as the main switch to connect and to disconnect the winterization system circuit. Push in the circuit breaker button all the way to connect the system; pull out the button to disconnect the system. The circuit breaker trips off automatically (par. 19*c*(1)) whenever the circuit becomes heavily overloaded. To reset the circuit breaker after it has tripped, push in the button.

(2) *Start—run switch.* The START—RUN toggle switch (4) is used to start and to run the winterization heater. To start the heater, after the RESET button has been pushed in ((1) above), hold the START-RUN switch in the START position from 2 to 4 minutes. After the heater OPERATING indicator lamp ((3) below) flashes on, place the START-RUN switch in the RUN position. To shut off the heater, place the switch in the OFF position.

(3) *Heater operating indicator lamp.* The primary purpose of the heater OPERATING indicator lamp (5) is to show when the heater is in operation (par. 19*c*(2)). The lamp also may be used as a check on the power supply to the heater. To check the power supply, be sure the circuit breaker (RESET) button ((1) above) is in all the way. Then press the (OPERATING) indicator. If power is available, the lamp will glow.

d. Miscellaneous (fig. 11).

(1) *Duplex receptable.* A CONVENIENCE OUTLET duplex receptable (23), mounted on the control panel, is used as a means of connecting external power for trouble shooting the lamps, fans, etc., that require 120-volt, 60-cps (cycle per second) power. This receptable is *not* intended to carry the load of the generator. The receptable

is of the twist-lock type and contains two connectors.

(2) *Convenience outlet circuit breaker.* The CIRCUIT BREAKER (1) mounted on the control panel, is used as a main switch to connect and to disconnect the CONVENIENCE OUTLET circuit. Push the CIRCUIT BREAKER button in all the way to connect the system; pull out the button to disconnect the system. The CIRCUIT BREAKER trips off automatically (par. 19*e*) whenever the circuit becomes heavily overloaded. To reset the CIRCUIT BREAKER after it has tripped, push in the button.

(3) *Panel light toggle switch.* A PANEL LIGHT ON-OFF switch (21), mounted on the control panel, is used to turn the panel lamp on and off.

(4) *Battery-charging circuit breaker.* The battery-charging circuit breaker (BATTERY CHARGE BREAKER), mounted on the control panel, is used to protect the battery-charging circuit. If the circuit becomes overloaded, the circuit breaker will trip off. To reset, push down the lever all the way to the OFF position, then up to the ON position. Before starting the unit, place the circuit breaker in the ON position.

19. Automatic Controls

a. Engine.

(1) *Engine-speed governor* (fig. 2). An engine-speed governor (6), mounted on the right side of the engine, regulates the speed of the engine which governs the output frequency. The governor is belt-driven from the crankshaft pulley and is connected to the carburetor throttle through an adjustable linkage. The governor is factory-set and should require no adjustment. However, if an adjustment is necessary, refer to paragraph 25*b* and proceed as instructed.

(2) *Engine-overspeed safety governor* (fig. 2). A velocity-type overspeed safety governor (10) is installed between the carburetor and intake manifold. This governor will prevent the engine from running away in case the engine-speed governor or its drive belt fails. To check the adjustment of the overspeed safety governor, refer to paragraph 46 and proceed as instructed.

(3) *High-coolant-temperature cutoff switch* (fig. 3). The engine is equipped with a thermostatically operated high-coolant-temperature cutoff switch (11), mounted on the cylinder head coolant outlet elbow. If the coolant temperature exceeds a predetermined value, the switch opens the ignition circuit and thereby stops the engine. The switch is adjustable to permit selection of any desired temperature between 160°F. and 220°F. It is factory-set at 200°F.

(4) *Low-oil-pressure cutoff switch* (fig. 2). A low-oil-pressure cutoff switch (17), mounted on the right side of the engine, is provided to open the ignition circuit if the engine oil pressure drops below a safe minimum of approximately 5 psi for engine operation. During starting, and until the engine reaches operating speed, the ignition system will bypass the cutoff switch.

(5) *Automatic choke* (fig. 2). An automatic, electric-thermal-type choke (22) is installed on the exhaust pipe adapter below the exhaust manifold. When the engine is cranked electrically, the carburetor is choked automatically to the extent required by the temperature of the engine.

b. Generator.

(1) *Circuit breaker* (fig. 11). The ON-OFF CIRCUIT BREAKER (18), mounted on the control panel, is designed to trip automatically if the circuit becomes heavily overloaded. The thermal trip release is factory-set for time-delay operation. To reset or manually operate the CIRCUIT BREAKER as a load switch, and to

readjust the load setting, refer to paragraph 18*b*(1) and proceed as instructed.

(2) *Voltage regulation system.* Voltage regulation is maintained by a plug-in type voltage regulator (4, fig. 4), a resistance network, a rheostat-type VOLTAGE REGULATOR CONTROL (20, fig. 11), and a toggle switch (VOLTAGE REGULATOR SW) (19). The voltage regulation system automatically maintains the required voltage output under any condition of load. For instructions on adjusting the voltage regulator, refer to paragraph 25*b*(4) and proceed as instructed. For manual operation of the VOLTAGE REGULATOR CONTROL, refer to paragraph 18*b*(2).

c. Winterization System.

(1) *Circuit breaker* (fig. 11). The circuit breaker (RESET) (6) trips automatically when the heater circuit becomes heavily overloaded. For use as a master switch and for the method of resetting, refer to paragraph 18*c*(1). The push-button type circuit breaker is mounted on the control panel and is designated (RESET).

(2) *Heater operating indicator lamp* (fig. 11). The heater OPERATING indicator lamp (5), mounted on the control panel, indicates when the heater is operating. The lamp will glow when the heater is burning on either high or low fire, or after the heater has been turned off and is purging itself of fuel. To operate the lamp as a check on the winterization system power supply, refer to paragraph 18*c*(3).

d. Battery Charging. A dry-disk selenium rectifier (5, fig. 4), located on the firewall, and a voltage transformer (2, fig. 4), located in top of the generator stator housing, provide charging current for the batteries. The rectifier changes ac to dc and the transformer maintains the specified charging rate. A battery-charging circuit breaker (22, fig. 11), located on the control panel, serves to protect the system. For method of resetting, refer to paragraph 18*d*(4).

e. Convenience Outlet Circuit Breaker (fig. 11). The CIRCUIT BREAKER (1) trips automatically when the convenience outlet circuit becomes heavily overloaded. For use as a master switch and for the method of resetting, refer to paragraph 18*d*(2).

20. Instruments

a. Engine (fig. 11). All the engine instruments are located on the instrument panel.

(1) *Oil-pressure gage.* The oil-pressure gage (9) indicates the pounds per square inch of oil pressure being delivered to the engine bearings. The gage is of the electric type and will not operate unless the batteries are connected. The gage has a 0- to 60-pound scale, and normal oil pressure is from 15 psi to 25 psi. The pressure will be higher when heavy oil is used or when the engine is cold. When light oil is used or when the engine bearings are worn, the oil pressure will be lower. If the gage indication is not within the correct range, stop the unit and investigate the cause immediately. The oil pressure may be adjusted slightly by the method described in paragraph 25*b*(6).

(2) *Coolant-temperature gage.* The coolant-temperature gage (10) indicates the temperature of the engine coolant. The gage is of the electric type and will not operate unless the batteries are connected. The scale reading on the gage is from 100°F. to 220°F. Normal engine operating temperature is 180°F. If, after warm-up, abnormal temperature is indicated on the gage, proceed as follows: Check the coolant and engine-oil level; check the water pump, fan, fan belt, and thermostatic valve for proper operation. Never operate an overheated engine.

(3) *D-c ammeter.* The d-c ammeter (7) indicates the rate, in amperes, at which the batteries are being charged. The scale reading of the ammeter is from —15 to +15 amperes. At normal operating speed, the ammeter should

indicate a charging rate of +2 to +5 amperes when the batteries are fully charged. If the batteries are low, the charging rate will be higher. When the heater is operating, the ammeter will show a negative reading. Negative readings also may indicate that the battery leads are reversed or that there is a short circuit in the system. No reading on the ammeter indicates a faulty charging system, a loose or broken connection, that the BATTERY CHARGE BREAKER is in OFF position, or a faulty meter.

b. Generator (fig. 11). All the generator instruments are located on the instrument panel.

(1) *Voltmeter.* The voltmeter (15) is connected to read phase-to-phase voltage and has a maximum scale reading of 0–300 volts and 0–600 volts. A voltmeter selector switch (VOLTMETER SW) (16) provides facilities to check the voltage from phase to phase (A-B, B-C, C-A). With the generator operating under full balanced load, the voltmeter will indicate (in all phases) 120 volts in the parallel-delta connection, 240 volts in the series-delta connection, 208 volts in the parallel-wye connection, and 416 volts in the series-wye connection. Under no load, the voltmeter will register slightly higher. If the voltage is too high or too low, adjust the VOLTAGE REGULATOR CONTROL or MANUAL VOLTAGE CONTROL.

(2) *Ammeter.* The ammeter (13), connected to the generator circuit by means of current transformers and a selector switch (AMMETER SW) (14), registers phase current. The selector switch, which provides facilities for checking the current in each of the three phases, is designated A, B, C, and OFF, and provides a maximum scale reading of slightly more than 100 amperes. When the generator is connected for 120-volt output, parallel-delta, the ammeter will register 75 amperes under full load in all phases; when connected for 240-volt output, series-delta, the ammeter will register 37.5 amperes under full load in all phases; when connected for 120/208-volt output, parallel-wye, the ammeter will register 43.5 amperes under full load in all phases; and when connected for 240/416-volt output, series-wye, the ammeter will register 21.75 amperes under full load in all phases. Abnormal ammeter readings indicate an unbalanced load, defective ammeter, defective lines to the load, defective transfer switch, or defective current transformers.

(3) *Frequency meter.* The frequency meter (8) indicates the cycles per second of the current being produced by the generator. Engine speed determines the frequency of the generator output. The meter scale provides for indications of 59 to 63 cps. Under stable operation at full load, the frequency meter must indicate 60 cps. On no load, the meter will register slightly more than 60 cps. Any deviation from the desired reading can be corrected by changing the engine speed as described in paragraph 25*b*.

(4) *Running-time meter.* The running-time meter (11) is connected to the output of the generator. The meter registers the number of hours the generator has been operating. If the unit has been operating at a higher or lower frequency than normal (60 cps), the meter will not indicate exact true hours, but will still register the correct total hours of the machine, corrected to 60-cycle operation.

Section III. OPERATION UNDER USUAL CONDITIONS

21. Preliminary Procedure

Before starting, check the unit as follows:

a. Fuel System. Check the available fuel supply for the correct grade of fuel (Gasoline, Automotive Combat specification MIL–G–3056, symbol 86A). Check the auxiliary fuel hose for the proper connections (par. 12*c*). The fuel pump should be primed adequately (par. 16*a*). Examine all fuel fittings for loose connections.

b. Cooling System. Be sure the cooling system is filled to capacity (16 qts) with clean water. Check all hose fittings and drains for evidence of leakage and loose connections. Check the high-coolant-temperature cutoff switch for proper setting (par. 19*a* (3)).

c. Exhaust System. Check all exhaust connections for proper installation. Be sure the exhaust extension tube is assembled properly (par. 12*b*). *All connections must be gastight.*

d. Lubrication. The lubrication system must be prepared as instructed in paragraph 15. Recheck to be sure the crankcase oil level is correct.

e. Batteries. Check to make sure the batteries have been prepared properly for use (par. 17) and that all cable connections are correct and secure (par. 14*c*).

f. Instrument and Control Panel. Check all the instruments and controls located on the panel and within the unit for damage and insecure mounting. All electrical connections must be firm and proper. Refer to paragraph 18*b*(1) and adjust the load setting of the ON-OFF CIRCUIT BREAKER to the proper position as instructed. The circuit breaker must be in the OFF position unless the unit is to be started remotely.

g. Remote Starting. If the unit is to be operated from a remote location be sure the connections are correct (par. 14*b*). They must be clean and secure. The ON-OFF CIRCUIT BREAKER must be in the ON position for remote starting.

h. Output Connections. Check the wye-delta and series-parallel change boards for proper setting for the desired output. If incorrect, change as instructed in paragraph 14*a*. The output terminals must be connected to the load correctly and the connections secure and clean.

Caution: Never draw more than 50 amperes per leg through the small 3-pole output receptacle.

i. General Inspection. Check the fan drive belt and the engine-speed governor drive belt for proper tension (par. 46). Check the entire unit for loose nuts, bolts, electrical connections, and fittings. Remove all tools and waste material from around the unit. Be sure the operating location is ventilated properly.

22. Starting

Caution: Except when starting the unit from a remote location, do not attempt to start the unit with the main load ON-OFF CIRCUIT BREAKER in the ON position.

a. Automatic Starting (NORMAL OPERATION).

(1) To start the unit electrically, with the VOLTAGE REGULATOR CONTROL operative, proceed as follows:

(*a*) Make sure the main load ON-OFF CIRCUIT BREAKER is in the OFF position.

(*b*) Make sure the battery-charging circuit breaker is in the ON position.

(*c*) Place the EMERGENCY OPERATION-NORMAL OPERATION switch in the NORMAL OPERATION position.

(*d*) Place the START—STOP switch in the START position and hold it approximately 10 to 15 seconds. The starter will be disengaged automatically when the engine starts and comes up to speed. Then the switch can be released and the automatic circuit will hold the ignition circuit on. If the engine fails to start, release the switch for 10 seconds and then repeat the procedure. If the unit does not start after a few attempts, check the fuel and ignition systems and repeat the starting procedure. If the unit still

fails to start, refer to the trouble-shooting chart (par. 49) for the possible cause.

(*e*) Do not operate the manual CHOKE.

(*f*) To start the unit at idling speed, operate the manual THROTTLE as instructed in paragraph 18*a*(4). Place the EMERGENCY OPERATION — NORMAL OPERATION switch in the EMERGENCY OPERATION position.

(*g*) Check the battery-charging circuit breaker (BATTERY CHARGE BREAKER) to make sure that it has not tripped off.

Note. When a closed throttle (idling) condition is required to start the engine, the engine will then run at an idle speed below 1,000 rpm during the starting phase and will not permit relay K2 to close if the EMERGENCY OPERATION—NORMAL OPERATION switch is in NORMAL OPERATION position. (This is because the generator will not come up to full voltage.) Therefore, when starting with a closed throttle, make sure that the EMERGENCY OPERATION—NORMAL OPERATION switch is in the EMERGENCY OPERATION position. Place this switch in the NORMAL OPERATION position only after the closed throttle (idling) condition is no longer needed (*b*(7) below).

(2) To start the unit with the VOLTAGE REGULATOR CONTROL inoperative, proceed as follows:

(*a*) Make sure the main load ON-OFF CIRCUIT BREAKER is in the OFF position.

(*b*) Make sure the battery-charging circuit breaker (BATTERY CHARGE BREAKER) is in the ON position.

(*c*) Turn the MANUAL VOLTAGE CONTROL to full DECREASE position.

(*d*) Start the unit as instructed in (1) (*c*) and (*d*) above.

(*e*) After the unit has been started, set the MANUAL VOLTAGE CONTROL to the rated output voltage. Check the battery-charging circuit breaker to make sure it has not tripped off.

Note. If the MANUAL VOLTAGE CONTROL has been set at the rated output voltage (from the previous operation) and has *not* been changed, start the unit as instructed in (1) above.

b. Manual Start (EMERGENCY OPERATION). The engine may be started by hand cranking in the event the batteries do not supply sufficient power for cranking electrically. The batteries must, however, supply enough power for ignition. To start the engine manually, proceed as follows:

(1) Make sure the main load ON-OFF CIRCUIT BREAKER is in the OFF position.

(2) Make sure the battery-charging circuit breaker is in the ON position.

(3) Place the EMERGENCY OPERATION — NORMAL OPERATION switch in the EMERGENCY OPERATION position.

(4) Insert the hand crank and rotate it until it engages with the crankshaft.

(5) Pull out the manual CHOKE on the front of the unit if starting in cold temperatures.

(6) Crank the engine by using a strong, quick, upward pull. Repeat as necessary; be careful not to overchoke.

(7) After the engine starts, press the START—STOP switch momentarily in the START position and return the EMERGENCY OPERATION—NORMAL OPERATION switch to the NORMAL OPERATION position. This sets the relays and connects the high-coolant-temperature cutoff switch and the low-oil-pressure cutoff switch into the ignition circuit. Also, the unit cannot be stopped unless the EMERGENCY OPERATION—NORMAL OPERATION switch is in the NORMAL OPERATION position. Push in the manual CHOKE all the way.

Caution: If the engine does not start, place the EMERGENCY OPERATION — NORMAL OPERATION switch in the NORMAL OPERATION position, otherwise the

ignition circuit will continue to draw current.

c. Remote Operation. To start the unit from a remote location, connect the remote cables as instructed in paragraph 14*b* and proceed as follows:

(1) Place the main load ON-OFF CIRCUIT BREAKER in the ON position before starting the unit remotely. (It is assumed that there will be a load control at the load location. This control should be in the OFF position while starting.)

(2) With the EMERGENCY OPERATION — NORMAL OPERATION switch in NORMAL OPERATION position, the switches located at the remote points serve the same function as the START—STOP switch. (A voltmeter should be connected at the remote position to indicate when the unit has started.)

23. Precautions After Starting

Warning: Do not touch the wye-delta change board, series-parallel change board, or the output terminals while the unit is in operation.

a. Check the coolant, fuel, and oil lines for leakage. If leaks have developed, correct them immediately. Stop the unit if necessary.

b. Check the reading of the engine oil-pressure gage. It may read high during the first few minutes of operation when the oil is cold and thick. After the warm-up period, the gage should read between 15 psi and 25 psi. If a high or low oil-pressure reading is observed, stop the unit and refer to the troubleshooting chart (par. 49) for the possible cause.

c. The battery-charging ammeter should indicate a charging rate of +2 to +5 amperes with the batteries fully charged. If no charge or a discharge is indicated, refer to the troubleshooting chart (par. 49) for the possible cause.

d. Observe the readings of the voltmeter and the frequency meter. The voltmeter should register the readings as given under the no-load column in paragraph 6. The frequency meter should indicate between 60 and 62 cps. The frequency is factory-set and should be correct. However, if it is necessary to correct the frequency, refer to paragraph 25*b* and adjust the engine-speed governor as instructed.

e. The coolant temperature indicated should be 180° F. after the warm-up period, approximately 1 hour. If the temperature is above normal, remove the radiator cap and check the coolant level. Add coolant if necessary. Be careful when removing the radiator cap to avoid scalding.

f. After the warm-up period, the crankcase oil level will be slightly below the full mark on the oil level gage because of the oil capacity of the engine-speed governor and the oil filter. Stop the engine (par. 26) and check the oil level. Add oil as required.

24. Applying Load

a. Do not apply load to the unit until the engine has warmed up. Be sure the load is within the range of the unit.

b. To apply the load to the unit, place the main load ON-OFF CIRCUIT BREAKER in the ON position. Check the ammeter, voltmeter, and frequency meter readings immediately. Compare them with the correct readings listed in paragraph 20*b*. Any deviation must be investigated and corrected at once. If the circuit breaker automatically trips off after applying the load, recheck for overload conditions, incorrect connections, or incorrect setting of the circuit breaker. To reset, push the ON-OFF CIRCUIT BREAKER lever beyond the OFF position and then back to ON. Never manually hold the circuit breaker in the ON position.

25. Operating Procedure

a. Instrument Readings. At frequent intervals during load operation, check the reading of the instruments located on the instrument panel. Refer to paragraph 20 for normal instrument indications and the operations necessary to correct abnormal readings.

b. Adjustments. Adjustments necessary to correct abnormal operation of the unit are explained below.

Note. Do not attempt to adjust the engine-speed governor unless the remainder of the engine is in satisfactory condition.

(1) *Governor adjustment to correct frequency* (fig. 13). If the indicated

frequency is abnormal, correct the frequency by adjusting the engine-speed governor as follows:

(*a*) With the engine dead, loosen the locknut (1) located on the linkage between the governor and carburetor. Adjust the linkage by turning the sleeve (2) until the dimension A is approximately 6⅞ inches. (This length is such that the governor arm movement will close and open fully the carburetor butterfly valve.) Check the eyebolt dimension B. This should be seven-eighths inch. To increase the dimension, loosen the upper adjusting nut (9) and tighten the lower adjusting nut (1). To decrease, loosen the lower adjusting nut (10) and tighten the upper adjusting nut (9). Be sure to tighten both nuts when the adjustment is completed.

(*b*) Start the engine. With the unit running at approximately 60 cps under no load, lengthen the linkage by turning the sleeve (2) until an increase in engine speed is effected. Then turn the sleeve back until the governor just begins to take control and the generator frequency is restored to 60 cps. Tighten the locknut.

(*c*) Loosen the two shoulder screws (3) that hold the adjustment slide (4) in place. Loosen the locknut (5) and change the engine speed by turning the adjustment screw (6). (To increase the engine speed, turn the screw clockwise; to decrease the speed, turn the screw counterclockwise.)

(*d*) When the frequency meter indicates 60 cps under load or about 62 cps under no load, secure the adjustment by tightening the locknut (5) and the shoulder screws (3). If necessary, readjust the linkage between the governor and carburetor ((*a*) and (*b*) above).

(2) *Governor adjustment to correct engine surge under no load* (fig. 13). If the engine is hunting or surging under no load, correct the condition by adjusting the engine-speed governors as follows:

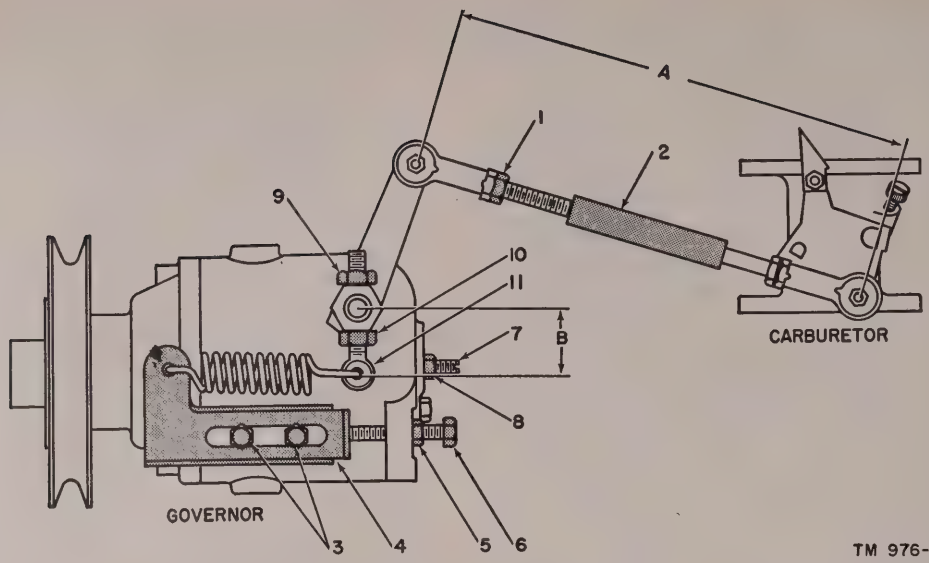
(*a*) Loosen the locknut (8) and turn the bumper screw (7) in until the engine stops surging. Do not turn the bumper screw in too far or the engine speed will increase and the governor will not function properly.

(*b*) When the bumper screw has been adjusted properly, secure the setting by tightening the locknut (8).

(*c*) If the frequency drop from no load to rated load is greater than specified (62 cps to 60 cps), decrease dimension B as follows: Loosen the lower adjusting nut (10) and tighten the upper adjusting nut (9). Then readjust the no-load speed of the engine ((1) (*d*) above) until a frequency of 62 cps is obtained.

(3) *Governor adjustment to correct engine surge under load* (fig. 13). If the engine is hunting or surging under load, correct the condition by increasing dimension B. To do this, loosen the upper adjusting nut (9) and tighten the lower adjusting nut (10). Readjust the engine no-load speed in accordance with (1) (*c*) above.

(4) *Voltage regulator adjustment.* If voltage hunting occurs, or if the voltage regulator is sluggish in response, remove the regulator cover and adjust the dashpot by turning the adjusting screw one-eighth or one-quarter of a turn in either direction to obtain optimum response. If the sweep of the VOLTAGE REGULATOR CONTROL is not great enough to control the rated output voltage, adjust the variable resistor (2, fig. 5), mounted on the rear of the firewall, as follows: With the unit shut down, place the VOLTAGE REGULATOR CONTROL in midposition. Slide the ad-



1 Locknut
2 Sleeve
3 Shoulder screw (H395, H396)
4 Adjustment slide (A 37)
5 Locknut
6 Adjustment screw (H386)
7 Bumper screw (H380)
8 Locknut
9 Upper adjusting nut (H391)
10 Lower adjusting nut (H393)
11 Control-arm eyebolt (H394)

Figure 13. Engine-speed governor adjustments.

justable lug on the resistor up to increase and down to decrease the resistance in the circuit. The adjustment is correct when the voltmeter indicates the rated output voltage with the VOLTAGE REGULATOR CONTROL placed in midposition.

Note. When adjusting the variable resistor (2, fig. 5), be sure that the screw that holds the adjustable band is loosened completely before attempting to move the band.

(5) *Carburetor adjustments.* The carburetor is provided with two external adjustments, the idle adjusting screw and the altitude adjusting screw. If it is determined that the idle job is definitely out of adjustment, correct the condition as follows: Start the engine and set the manual THROTTLE to maintain an engine speed of approximately 500 to 600 rpm or about one-third normal operating speed under no load. When the engine has reached a normal operating temperature of 180° F., turn the idle adjusting screw (13, fig. 20) clockwise until the engine starts to falter or roll because of a lean fuel mixture. (Do not turn the adjusting screw in too far or the needle valve will become damaged and it will be impossible to obtain the correct adjustment.) Then turn the screw in the opposite direction (counterclockwise) until the engine runs smoothly. Proper adjustment ordinarily will be between ½ and 1½ turns open (counterclockwise) from a completely closed position. The adjustment should be rechecked after the unit has been operating under load for approximately one half of an hour. The altitude adjusting screw is factory-set for an air-fuel ratio of 13.4 to 1 at 12.5-kw output. The factory setting is calculated to give maximum operating efficiency at any altitude up to 5,000 feet. Because special equipment is necessary to adjust the altitude jet (par. 62*f*(2)), operating personnel must *never* attempt adjustment. Adjustment should be made by repair personnel and is necessary only after the carburetor has been overhauled.

(6) *Oil-pressure adjustment* (fig. 45). The oil-pressure can be altered slightly by adding or removing shims in the relief valve located on the side of the oil

pump body. Adding shims between the retainer (9) and the spring (11) will increase the oil pressure. Removing the shims will decrease the oil pressure. This adjustment will change the pressure at load speed (1,800 rpm) but not at idle speed.

26. Stopping

Note. The EMERGENCY OPERATION—NORMAL OPERATION switch must be in the NORMAL OPERATION position before the unit can be stopped.

a. Disconnect the load by throwing the ON-OFF CIRCUIT BREAKER to the OFF position. (If the unit is operated from a remote point, leave the circuit breaker in the ON position and disconnect the load at the remote location.)

b. Allow the unit to run a few minutes under no load; then stop the unit by momentarily depressing the START—STOP switch to the STOP position.

c. After stopping the engine, check the coolant and the engine-oil level. Add oil and coolant as required. Clean the engine thoroughly and be sure the unit is prepared for the next run. When not in operation, inclose the unit in the canvas cover supplied with the equipment.

Section IV. OPERATION UNDER UNUSUAL CONDITIONS

27. Operation in Arctic Climates

To operate the unit in subzero temperatures, special precautions must be taken to prevent poor performance or total operational failure. The equipment can operate effectively under extreme cold conditions (to —65° F.) only if the procedures listed below are followed carefully. If possible, install the unit in a properly ventilated heated shelter.

a. Service and Maintenance.

(1) *Fuel system.* In freezing temperatures, there is danger of water and ice forming in the fuel system. Store the fuel in tightly closed containers. Keep the containers as full as possible at all times. For subzero operation, use fuel conforming to specification MIL–G–3056, type C. Drain the fuel filter to remove any accumulation of water. If ice forms in the fuel lines and supply tank, proceed as follows: Remove the lines and thaw the ice. Blow out the moisture with compressed air. Drain off any water which has accumulated in the fuel tank and refill the tank. When operating the unit in freezing temperatures, add one half pint of denatured alcohol to each 5 gallons of gasoline. This will prevent the formation of ice in the fuel system.

(2) *Lubrication.* Because oil and grease congeal easily and gummy parts move sluggishly in arctic weather, it is essential for efficient operation to keep all moving parts clean and dry. If lubrication is necessary, always use Grease, Aircraft and Instruments (GL). Be sure the carburetor choke valve and shaft are clean. Keep snow, water, and ice from collecting on lubrication points and lubricate more frequently than usual. For subzero operation, use Oil, Engine, Subzero (OES), conforming to specification MIL–O–10295 (ORD) as prescribed in the lubrication chart (fig. 17). If the unit is to remain idle for prolonged periods in subzero temperatures, drain the crankcase.

(3) *Cooling system.* If temperatures below freezing are anticipated, protect the cooling system with antifreeze. Under average climatic conditions, use ethylene-glycol type antifreeze. In arctic areas, used Compound, Antifreeze, Arctic.

(*a*) Before adding antifreeze, the cooling system must be thoroughly free of rust. Clean the entire cooling system thoroughly with Cleaning Compound with Inhibitor, ORD 51–C–1568–500.

(*b*) When the cooling system has been thoroughly cleaned, check for leaks and be certain that all hose, hose

clamps, and connections are in good condition and secure. Under average conditions, fill the cooling system about one-third full with clean water and then add ethylene-glycol type antifreeze to protect the system to the lowest anticipated temperature. The system should be protected to 10° F. below the lowest temperature that is anticipated. Use ethylene-glycol type antifreeze in accordance with the following table.

Lowest temperature anticipated (° F.)	Pints of antifreeze per gallon of cooling system capacity
+20	1½
+10	2
0	2¾
—10	3¼
—20	3½
—30	4
—40	4¼
—50	4½
—60	4¾

(*c*) When operating in arctic areas or in areas where the temperatures are such that ethylene-glycol type antifreeze cannot be readily mixed with water or where it cannot be stored without extreme difficulty, drain the cooling system completely and fill the system with Compound, Antifreeze, Arctic. It is imperative, when using arctic-type antifreeze, that the cooling system be thoroughly purged of all residual water before filling the system with the antifreeze.

(4) *Batteries.* When operating the equipment in temperatures below 0° F., remove Batteries BB–221/U and substitute Batteries BB–2221/U. In arctic climates it is essential to keep the battery electrolyte at the proper level and the batteries fully charged. The danger of the electrolyte freezing depends in the full-charge specific gravity of the electrolyte and the state of charge. The electrolyte will become mushy with ice crystals at —63° F. with the specific gravity at 1.250 and at —18° F. with the specific gravity at 1.200. When the batteries are not in use store them in a warm place.

(5) *Air cleaner.* If the unit is to be operated always in temperatures below freezing, remove the oil from the air cleaner. Wash the air cleaner parts thoroughly in cleaning solvent and blow them dry with compressed air. Reassemble the air cleaner and refill the oil bowl to the oil level mark, with oil, (OES).

b. Starting. To facilitate starting in subzero temperatures, the unit is equipped with a winterization system which heats the coolant, engine oil, and intake manifold. (For a description of the system refer to par. 5*h*.) To start the unit with the aid of the winterization system, proceed as follows:

(1) Check the fuel supply and fully prime the fuel system as instructed in paragraph 16*a*.

(2) Make sure that the choke has been adjusted for low-temperature operation (par. 62*g*).

(3) Remove the plug from the heater blower.

(4) Press the heater RESET button in.

(5) Check the electrical supply by pushing the heater OPERATING indicator lamp. If power is available, the lamp will glow.

(6) Hold the heater START—RUN switch in the START position until the indicator lamp flashes on (approx. 2 to 4 min.). This indicates that the heater has started.

(7) Move the START—RUN switch to RUN position.

Note. The sound of combustion may be heard before the indicator lamp flashes on; however, do not move the switch to the RUN position until the indicator lamp lights. If the lamp does not light within 5 minutes, move the START-RUN switch to OFF position and consult the troubleshooting chart (par. 49).

Caution: The heater exhaust contains carbon monoxide. Never operate

the heater without making adequate provision for thorough ventilation of the inclosure within which the equipment is being operated.

(8) Keep the heater on approximately 20 to 30 minutes until the engine is sufficiently warm to start and to operate smoothly.

Note. If it is necessary to maintain the unit in a stand-by condition for a long period of time, the heater will automatically switch to *low-fire* operation when the engine coolant reaches 150° F. The system will continue to operate on *low-fire* or *high-fire* operation depending on the temperature of the engine coolant; thus, the equipment can be started immediately at a moment's notice.

(9) Start the unit in accordance with instructions in paragraph 22. Prime the engine slowly with one stroke of the PRIMING PUMP while the engine is being cranked. If the engine does not start within 15 to 20 seconds, wait 5 minutes and then repeat the starting procedure.

Caution: Fuel does not vaporize readily in subzero temperatures. Be careful not to overprime.

(10) When the unit has reached operating temperature, shut off the heater. To stop the heater, move the START—RUN switch to OFF position. The indicator lamp will remain lighted until the heater has purged itself of fuel and will then go out automatically. Pull out the RESET button.

c. Stopping. Refer to paragraph 26 and stop the unit as instructed. Recheck the arctic service and maintenance instructions; use adequate precautions to protect the unit when not in use.

28. Operation in Desert Climates

Locate the equipment in an area protected from sand and dust. Inspect and clean the equipment more frequently than under normal operating conditions. Keep the unit covered when not in operation.

a. Fuel System. Be sure all fuel line connections are tight. Keep the fuel supply tank tightly closed to prevent the entrance of dirt and sand. Clean the fuel filter element more frequently than under normal conditions.

b. Lubrication. Keep all moving parts well cleaned and lubricated when the unit is being operated in desert areas. Always remove sand, dirt, and the old lubricant from the parts before relubrication. Check and change the engine oil often, depending on the severity of the climate, presence of excessive dust conditions, and frequency of operation. Drain the oil in the filter with each change of engine oil.

c. Cooling System. Proper ventilation of the cooling system is of prime importance. Keep the system full of clean water, and keep the radiator cap tight.

d. Batteries. Check the level of the electrolyte in the batteries more frequently than under normal operating conditions. Keep the vent caps tightly in place.

e. Air Cleaner. Keep clean oil in the air cleaner to prevent dust from entering the engine. Clean the air cleaner and change the oil at frequent intervals, depending on the severity of the climate. Under these conditions, never operate the unit with the air cleaner dry.

29. Operation in Tropical Climates

When operating in hot, humid climates, the equipment must be provided with unobstructed ventilation. Locate the unit so that it is protected from the direct rays of the sun. Shorten the time between normal lubrication periods. Keep the cooling system full of clean water. If the unit is to remain idle for long periods in humid areas, run it every few days for at least 1 hour to prevent the accumulation of moisture in the stator housing and engine. Never run the unit for only a few minutes; always operate it for at least 1 hour. In tropical climates, prepare the batteries as instructed in paragraph 17 with the following modifications: When using batteries in tropical climates, use electrolyte of about 1.225 specific gravity when fully charged. This milder strength of acid is less deteriorating to separators and plates, which results in longer battery life. The following table lists the specific gravity values to be used in tropical climates for batteries in various states of charge. The values shown in the table are for

electrolyte at the correct filling height and at 80° F.

State of charge	Specific gravity used in tropical climates
Fully charged	1.225
75% charged	1.180
50% charged	1.135
25% charged	1.090
Discharged	1.045

30. Operation in High Altitudes

The unit will operate at rated performance at elevations from sea level to 5,000 feet above sea level with no major adjustments. At high altitudes, however, the engine is more apt to overheat than at sea level. It is important to keep the cooling system full and to provide adequate ventilation. The unit will operate at altitudes above 5,000 feet, but at reduced power.

CHAPTER 3

ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. ORGANIZATIONAL TOOLS AND EQUIPMENT

31. Supply Reference

All tools, parts, and equipment supplied with Power Unit PU–26A/U are listed in paragraph 8 of this manual. See Department of the Army Supply Manual Sig 7 & 8 PU–26/U for maintenance parts and stock numbers.

32. Use and Care of Tools

a. Use of Tools.

(1) *General.* The proper use of tools is important. Improper use will damage the tools and equipment and may result in personal injury.

(2) *Wrenches.* When tightening a nut, bolt, or cap screw, be sure to use the proper wrench for the job. Do not use a wrench that is slightly worn or one that is oversize. This will result in rounding the nut, bolt head, or screw head and may cause damage to the equipment and personal injury if the wrench should slip. Never use pliers for tightening or loosening nuts, bolts, or cap screws. Always use an open-end wrench, a box wrench, or a socket wrench, if available. If none of these are available, use an adjustable wrench. When tightening cylinder-head fastenings, use a torsion wrench. Never use a pipe or other means to increase the leverage as this will bend or break the wrench and may strip the threads.

(3) *Screw drivers.* When loosening or tightening a fastening which has a slotted head, use a screwdriver with a blade that fits the slot on the head of the fastening. Do not use a wrench or pliers to increase leverage. Be sure to keep the blade of the screw driver square in the slot of the fastening. Never use a screwdriver as a pry bar or a chisel.

(4) *Other tools.* Specific tools are made for specific purposes. Be sure to use the right tool for the job and be sure that it is of the correct size for the work to be done.

b. Care of Tools. The condition in which a mechanic keeps his tool equipment is a good indication of his ability. Do not abuse tools by using them for work for which they were never intended. Keep all tool equipment properly stowed and protected from dirt and dampness when they are not in use. After using a tool, clean it thoroughly and replace it in its proper place in the tool box. Keep all tools free from rust and keep adjustable tools, such as pliers and adjustable wrenches, lubricated. Keep the tool box clean and free from all foreign matter and debris. After cleaning the tools and before putting they away, wipe them with a cloth that has been moistened with oil.

Section II. LUBRICATION AND PRESERVATION

33. Lubricants

The following table lists the lubricants, solvents, and preservative materials approved for use with Power Unit PU–26A/U.

Symbol	Nomenclature	Specification	Application
OE	Oil, engine, heavy duty	MIL–O–2104 (ORD)	Engine crankcase, air cleaner, igniter assembly.
OES	Oil, engine, subzero	MIL–O–10295 (ORD)	Engine crankcase.
GL	Grease, aircraft and instruments (for low and high temperatures).	MIL–G–3278	Carburetor-to-governor linkage bearings, priming pump, throttle, manual choke, generator bearing.
SD	Solvent, dry-cleaning	Federal P–S–661a	Cleaning.
D–40 or D–35	Fuel oil, diesel	MIL–F–896	Cleaning.
WB	Grease, general purpose, No. 2	MIL–G–2108	Battery cables and terminals.
PE	Oil, engine, preservative	USA 2–126	Rustproofing.

34. Lubricating Periods

Lubrication instructions frequently are given in periods of days, weeks, months, half-years, and years. A daily period of operation consists of any consecutive 8-hour period or any number of periods of operation that total 8 hours. A weekly period of operation is any number of operating periods that total 64 hours. A monthly period of operation is any number of operating periods that total 256 hours. A half-yearly period of operation is any number of operating periods that total 1,024 hours. A yearly period of operation is any number of operating periods that total 2,048 hours.

35. Factory-Lubricated Parts

a. Generator Bearing. The generator ball bearing is factory-packed with grease (GL), conforming to specification MIL–G–3278. The bearing is sealed to prevent the entrance of dirt and moisture, and to prevent the escape of the lubricant. Repacking the bearing with grease should never be necessary except in an emergency or whenever the generator is disassembled and overhauled. The bearing is a double-seal Fafnir Plya-Seal type. The Plya-Seal is a diaphragm-type contact seal, composed of two members, a flat, flexible sealing washer of synthetic rubber-impregnated fabric, and a split retaining ring of thin spring steel. The two members of the seal can be removed readily for inspection, cleaning, and lubrication of the bearings. (To remove the retaining ring, pry up on the ring about 90° away from the split portion.) At the time of overhaul of the generator, remove the bearing seals and, if necessary, add new grease (GL). Do not pack the bearing too full. If there is evidence of dirt or grit in the bearing, remove both seals and thoroughly flush the old grease from the bearing with clean hot oil.

b. Water Pump Bearing. The water pump has a factory-sealed, prelubricated bearing, and no further lubrication is required.

c. Heater Blower Motor. The bearings of the heater blower motor are factory-lubricated and no additional lubrication is necessary.

d. Starting Motor. The starting motor bearings are factory-lubricated and no further lubrication is necessary.

36. Routine Lubrication

a. Lubrication Orders. Each power unit is provided with an official lubrication order or a lubrication chart. Official lubrication orders are illustrated, numbered, and dated cards or decalcomania labels which prescribe approved lubrication instructions for mechanical equipment which requires lubrication by using organizations. Current lubrication orders should be requisitioned in conformance with instructions and lists in SR 310–20–4. Instructions contained in lubrication orders are mandatory and supersede all conflicting lubrication instructions of an earlier date.

b. Lubrication Instructions. The following subparagraphs contain detailed lubrication and cleaning information and are supplementary to the instructions in the lubrication chart (fig. 17).

(1) *Engine crankcase.* Check the crankcase oil level daily (after 8 operating hrs.) and add oil (OE) if necessary. Change the engine oil weekly (after 64

operating hrs.). Drain the oil by opening the drain cock located on the right side of the engine oil pan. Oil should be drained while the engine is warm. Refill the crankcase with 4 quarts of oil (OE) in accordance with the lubrication chart (fig. 17).

(2) *Air cleaner* (fig. 14). Check the quantity of oil in the air cleaner cup weekly (after 64 operating hrs.). If the oil is below the caution level, add oil (OE) up to the normal level of the cup. At monthly intervals (after 256 operating hrs.), remove the air cleaner element and wash it in cleaning solvent. At the same time, clean the air cleaner cup and refill with oil (OE). To remove the element, first remove the cup. Unscrew the wing screw located on the bottom of the element until free of the element housing. Then pull the element out of the housing. The wing screw does not come out of the element.

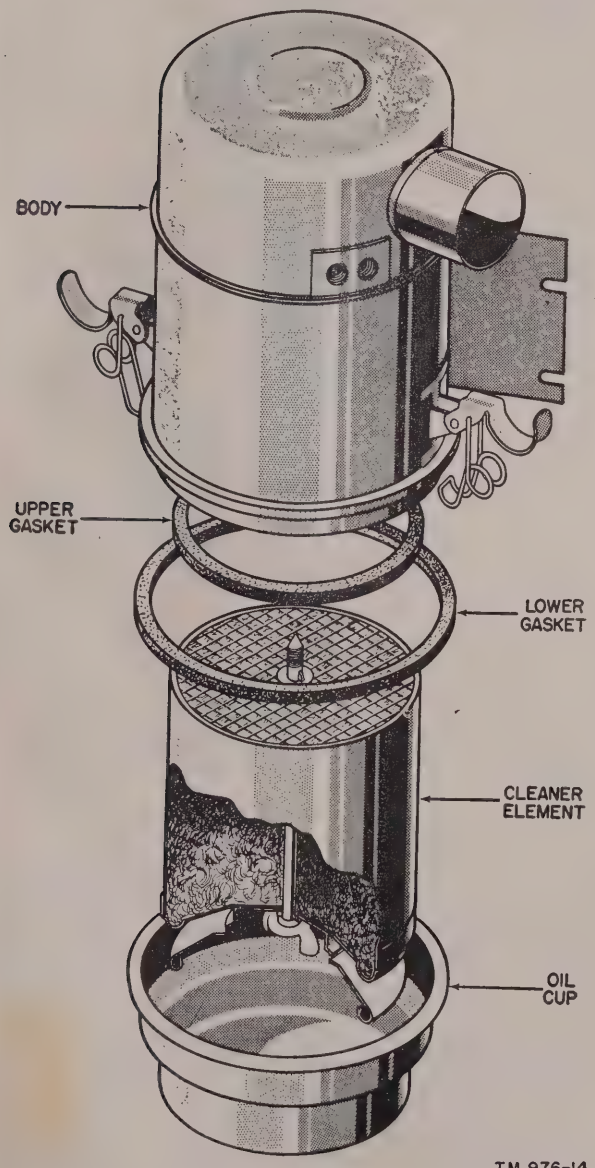


Figure 14. Air cleaner, exploded view.

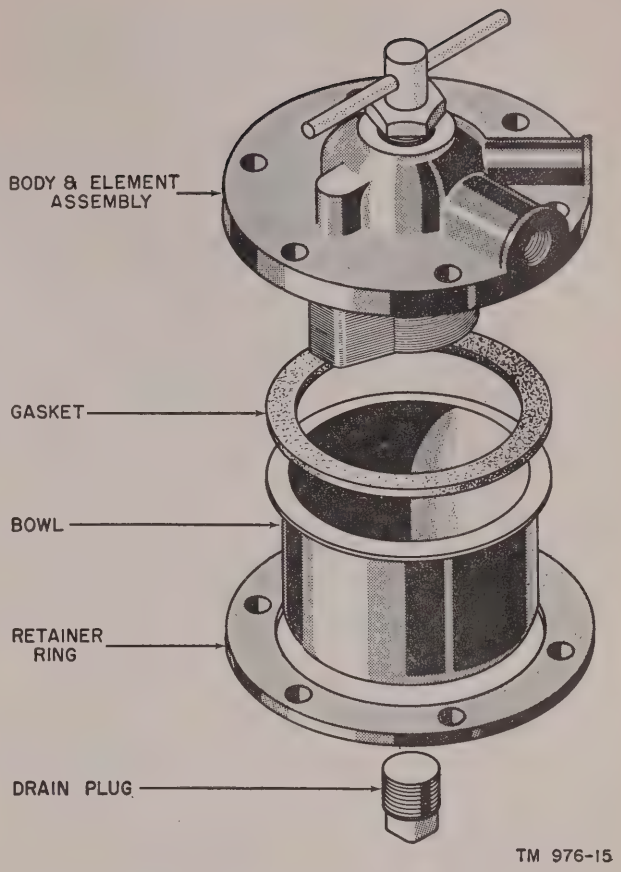


Figure 15. Oil filter, exploded view.

(3) *Oil filter* (fig. 15). Clean the oil filter element at least once each day (after 8 operating hrs.) by rotating the external handle one complete turn in either direction. Remove the plug in the filter bowl and drain the oil in the filter with each crankcase oil change (after 64 operating hrs.). If the handle becomes difficult to rotate, remove the element from the housing and wash it in cleaning solvent. Clean

the bowl and replace the bowl gasket. If the element disks or blades are damaged, replace the body and element assembly.

(4) *Fuel filter* (fig. 16). After each day of operation (8 operating hrs.), open the fuel filter drain to remove any accumulated dirt and water. This is particularly important when operating in damp or cold climates. At least once each month (after 256 operating hrs.), remove the filter element and wash it in fuel oil (D–40 or D–35) or cleaning solvent. Be careful not to damage the element disks. Replace any worn gaskets.

(5) *Fuel pump* (fig. 28). To avoid difficulties created by moisture, remove the fuel pump bowl (2) and strainer screen (4), and clean thoroughly with cleaning solvent at least twice a year (after 1,024 operating hrs.). Be careful not to bend the screen. Replace the bowl gasket (3) if it is worn or damaged.

(6) *Carburetor-to-governor throttle linkage.* Once each month (after 256 operating hrs.) or sooner, if necessary, apply grease (GL) to the bearings in the throttle linkage. Use grease only as specified in the lubrication chart.

(7) *Priming pump, throttle, and choke.* Quarterly or after 512 operating hours, remove all dirt and old grease from the shafts of the PRIMING PUMP, manual THROTTLE, and manual CHOKE. Apply a thin coat of grease (GL) to the shafts.

(8) *Distributor* (fig. 30). Once every month or after 256 operating hours, remove the distributor cap cover and the distributor cap from the igniter assembly. Place 2 to 3 drops of oil (OE) on the felt wick under the rotor and on the breaker-arm pivot. Wipe the breaker cam lightly with grease (GL).

(9) *Heater fuel pump* (fig. 36). When operating the heater every day, remove and clean the heater fuel pump

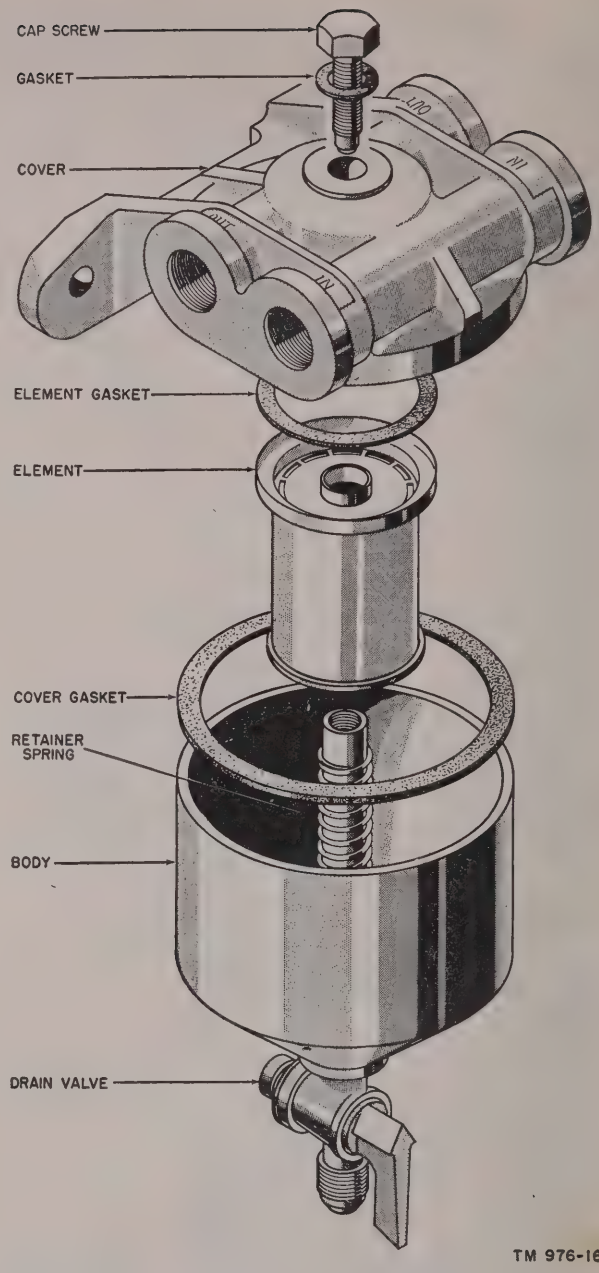
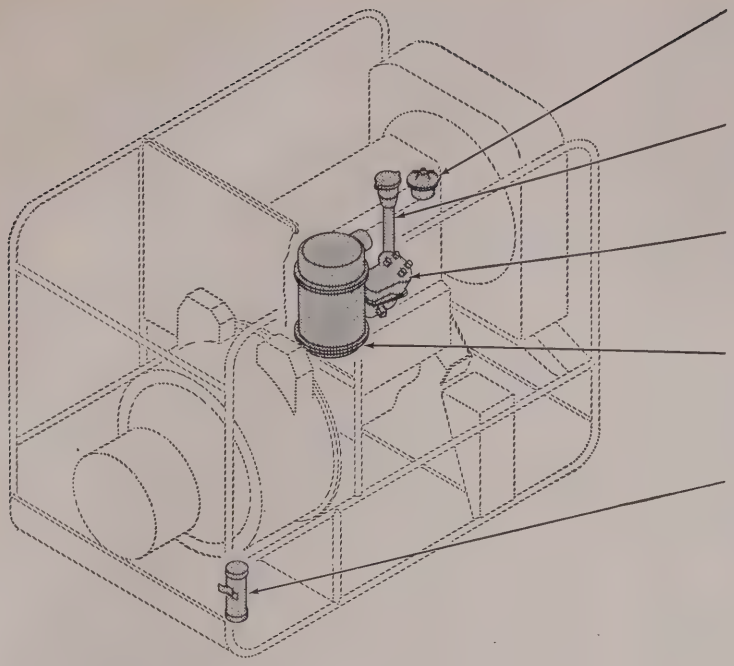


Figure 16. Fuel filter, exploded view.

strainer and cover daily (after 8 *unit* operating hrs.) with cleaning solvent or fuel oil (D–40 or D–35). Apply air pressure to remove any foreign particles which may have accumulated in the small magnetic separator chamber in the center of the pump cover. If the heater is in frequent operation, clean the fuel pump subassembly twice a year (after 1,024 *unit* operating hrs.) with cleaning solvent or fuel oil



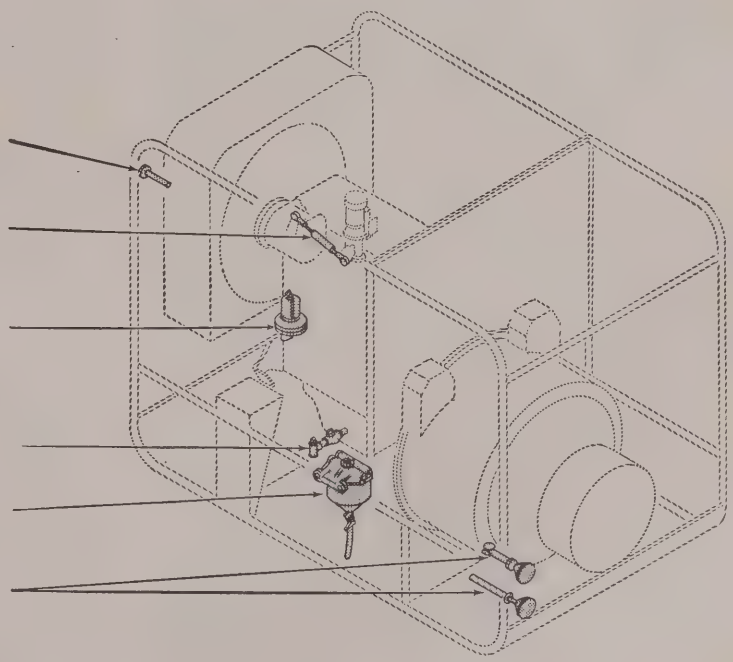
OIL FILTER
ROTATE HANDLE DAILY. DRAIN OIL WEEKLY.

CRANKCASE
CHECK OIL LEVEL DAILY AND REFILL WHEN NECESSARY. CHANGE WEEKLY WITH OE.

DISTRIBUTOR
ADD 2 TO 3 DROPS OF OE TO FELT IN CAM AND TO BREAKER ARM PIVOT EVERY MONTH.

AIR CLEANER
CHECK OIL LEVEL DAILY AND REFILL WHEN NECESSARY. CHANGE WEEKLY WITH OE. CLEAN ELEMENT AND BOWL WEEKLY WITH SD.

HEATER FUEL PUMP
CLEAN STRAINER DAILY AND SUBASSEMBLY SEMIANNUALLY WHEN HEATER HAS BEEN OPERATING FREQUENTLY. CLEAN WITH SD.



MANUAL CHOKE
GREASE QUARTERLY WITH GL.

CARBURETOR-TO-GOVERNOR LINKAGE
GREASE ROD END BEARINGS MONTHLY WITH GL.

FUEL PUMP
CLEAN STRAINER SCREEN AND BOWL SEMI-ANNUALLY WITH SD.

CRANKCASE DRAIN

FUEL FILTER
DRAIN DAILY. CLEAN ELEMENT MONTHLY WITH SD.

THROTTLE AND PRIMER PUMP
GREASE QUARTERLY WITH GL.

---KEY---

LUBRICANT	APPLICATION	TEMPERATURE	
		ABOVE +32° F	+32°F TO 0°F
OE—OIL, ENGINE	CRANKCASE, AIR CLEANER AND DISTRIBUTOR.	OE 30	OE 10
OES—OIL, ENGINE, SUBZERO	CRANKCASE AND DISTRIBUTOR	BELOW 0°F	
GL—GREASE, AIRCRAFT AND INSTRUMENTS	MANUAL CHOKE, THROTTLE, PRIMER AND CARBURETOR-TO-GOVERNOR LINKAGE	ALL TEMPERATURES	

TM 976-17

Figure 17. Lubrication chart.

(D–40 or D–35). To remove the strainer and subassembly, refer to paragraph 54*k* and proceed as instructed.

(10) *Engine-speed governor.* The engine-speed governor is continuously lubricated from the engine lubrication system. No further lubrication is necessary.

37. Weatherproofing

a. General. Signal Corps equipment, when operated under severe climatic conditions, requires special treatment and maintenance. Fungus growth, insects, dust, corrosion, salt spray, excessive moisture, and extreme temperatures are harmful to most materials.

b. Tropical Maintenance. A special moisture-proofing and fungiproofing treatment has been devised, which, if properly applied, provides a reasonable degree of protection. This treatment is explained in TB SIG 13 and TB SIG 72.

c. Lubrication. The effects of extreme cold and heat on materials and lubricants are explained in TB SIG 69. Observe all precautions outlined in TB SIG 69 and pay strict attention to all lubrication orders when operating the equipment under conditions of extreme cold or heat.

38. Rustproofing

Whenever the equipment is to be placed in storage or is to be out of service for a period of 30 days or more, precautions must be taken to guard against rust and against the formation of gum in the fuel system. Process the equipment as follows:

a. Materials Required. Requisition the materials below through regular channels and proceed with the rustproofing and gumproofing treatment immediately after shutting down the unit. Rustproofing must be done while the engine is still warm.

(1) Oil, Fuel, Diesel (D–35 or D–40), U.S. Army specification MIL–F–896.

(2) Oil, Engine, Heavy Duty (OE), specification MIL–O–2104 (ORD).

(3) Oil, Engine, Preservative, specification USA 2–126.

(4) Compound, Insulation, Ignition, Ordnance specification 3–182.

(5) Compound, Gum Preventive, Federal stock No. 51–C–1586–225.

(6) Tape, Adhesive, Waterproof Cloth, Signal Corps stock No. 6Z8624–1.

b. Procedure.

(1) Drain the lubricating system and fill the engine oil reservoir with preservative oil (PE).

(2) Connect the fuel line to a container of 5 gallons of gasoline to which one-quarter of a container of gum preventive compound has been added.

(3) Start the unit and operate it on the gasoline and gum preventive compound mixture for 5 minutes. Lift the free end of the fuel line from the container and permit the unit to stop by pumping the carburetor and fuel system dry.

(4) Remove the sediment bowl from the fuel pump assembly, clean it thoroughly and replace it on the unit.

(5) Disconnect the fuel line between the fuel pump and the carburetor and operate the hand lever on the fuel pump to make certain that all fuel has been removed from the pump.

(6) Disconnect the fuel line between the carburetor and the priming pump. Make sure that the carburetor and the priming pump are drained completely.

(7) Remove the spark plugs from the engine. Have someone crank the engine and, while it is being cranked, spray preservative oil (PE) into the cylinder through the spark plug holes.

(8) Remove the valve cover from the side of the engine block and spray the valve mechanism with preservative oil (PE).

(9) Drain the preservative oil from the engine. Attach a red tag to the engine oil filler which reads as follows:

Caution: This engine has been rust-proofed. Date_____ Use engine oil (OE) conforming to specifi-

cation MIL–O–2104 (ORD) or specification MIL–O–10295 (ORD) seasonal grade, when placing the unit back in service.

(10) After the engine has cooled, remove all grease, oil, and dirt from the exterior of the unit. Use solvent (SD). Remove all traces of rust and touch up all painted surfaces which have become damaged.

(11) Seal all breathers and breather holes, air intakes, and the exhaust outlet with nonhygroscopic tape.

(12) Make sure that all surfaces are dry, and spray all unpainted surfaces with insulation compound. Include all wiring and electrical equipment. Do not get this compound on the interior of the generator and exciter. Keep it away from such components as circuit breakers, switches, etc.

39. Painting and Refinishing

When painted surfaces of the equipment become scratched or otherwise damaged, rust and corrosion may be prevented by cleaning thoroughly and then touching up the damaged surfaces.

a. Remove all traces of oil or grease with solvent (SD); sandpaper thoroughly the portions to be refinished. Apply light, even coats of paint with a small brush. Two light coats are better than one heavy coat.

b. If the painted surfaces have become blistered from heat, remove all old paint with paint remover. Thoroughly sandpaper the surfaces or rub them down with steel wool. Apply a smooth, even priming coat, sandpaper it lightly, and then apply a finish coat.

Caution: Avoid getting paint on moving parts in such a manner as to hinder their movement. Do not paint electrical contacts; avoid getting paint into oil and breather holes.

Section III. PREVENTIVE MAINTENANCE

40. Definition of Preventive Maintenance

a. Purpose. Preventive maintenance is a systematic series of operations performed periodically to keep equipment operating at top efficiency. The primary purpose of preventive maintenance is to prevent major break-downs and consequent need for repair. The primary function of trouble shooting is to locate and correct existing defects.

b. Importance. Preventive maintenance is of utmost importance since the failure of inefficient operation of one piece of equipment may cause the failure of an entire system. It is necessary to inspect the power unit systematically each day that it is operated and at weekly intervals, so that defects may be discovered and corrected before they result in serious damage or failure.

c. Responsibility. Preventive maintenance services are the responsibility of operating organizations. They comprise the scheduled maintenance services performed by the power unit operator and maintenance personnel, respectively. Ordinarily, the power unit operator will replenish fuel and lubricants. He will perform necessary cleaning operations; tighten loose nuts, bolts, screws, and other fastenings; care for tools and accessories; and make such emergency repairs as are within the scope of his ability, tool equipment, and parts available. He will perform all daily lubrication operations before operation, at halt (during shut-down periods), and after operation. He will assist the unit mechanic in performing the weekly maintenance on the unit. Maintenance personnel will perform the weekly and monthly maintenance operations with the assistance of the unit operator. The unit mechanic will see that daily lubrication operations have been performed properly by the operator. Any maintenance or repair operations beyond the scope of maintenance personnel will be reported to the officer in charge.

d. DA Form 11–260 Services. DA Form 11–260 is reproduced in figure 69. Operations pertinent to Power Unit PU–26A/U that appear on this form have been circled on the reproduction. Refer to the appropriate paragraphs in this manual for detailed instructions for the performance of operations listed on the form. The

fact that an operation, instructions for the performance of which appear in this manual, is not listed on DA Form 11–260 does not excuse the operator or repairman from the performance of such operations.

e. DA Form 11–261 Services. DA Form 11–261 is reproduced in figure 70. Operations pertinent to Power Unit PU–26A/U that appear on this form have been circled on the reproduction. Refer to appropriate paragraphs in this manual for detailed instructions for the performance of operations listed on the form. The fact that an operation, instructions for the performance of which appear in this manual, is not listed on DA Form 11–261 does not excuse the operator or repairman from the performance of such operations.

41. Daily Maintenance Services

For purpose of the following instructions, a daily maintenance period is considered to be 8 hours of operation. Daily services will be performed in the specified sequence.

a. Before Operation. Before operating the unit, perform the following services:

(1) See that the auxiliary fuel hose is properly connected (par. 12*c*) and that the fuel pump is fully primed (par. 16*a*). Be sure there is an adequate amount of fuel available.

(2) Check the exhaust extension tube for correct installation (par. 12*b*).

(3) Be sure the cooling system and lubrication system are full. Check the oil level in the air cleaner.

(4) Examine all instruments and controls on the panel for damage and loose electrical connections.

(5) Check the fan drive belt and the engine-speed governor drive belt for proper tension (par. 46).

(6) If the unit is to be started, other than remotely, be sure the ON-OFF CIRCUIT BREAKER is in the OFF position; if the unit is to be started remotely, the circuit breaker should be in the ON position. (The load control at the remote point should be in the OFF position.)

(7) Check the wye-delta and series-parallel boards for the proper setting for the desired output (par. 14*a*). See that all output connections are correct and well secured.

(8) Check the load adjustment on the ON-OFF CIRCUIT BREAKER for proper setting (par. 18*a*(1)).

(9) Check the battery-charging circuit breaker. It should be in the ON position.

(10) Check all fuel, coolant, lubrication, and exhaust connections for evidence of leakage.

(11) Examine the surrounding area for foreign matter and obstructions which may cause damage to the equipment.

(12) Be sure the inclosure in which the unit is to be operated is properly ventilated (par. 9*c*).

b. During Operation. After the engine has been started (par. 22) and warmed up, perform the following services:

(1) Check the engine instruments for any abnormal indications (par. 20*a*) before applying load.

(2) After the load has been applied, check all the instruments (par. 20) to be sure that the indicated values are within the rated range of the equipment. Check the instrument readings frequently during operation.

(3) Check the fuel supply periodically to avoid running out of fuel.

(4) Always be alert for any evidence of abnormal operation and for unusual noises or conditions.

c. At Halt. Disconnect the load by placing the ON-OFF CIRCUIT BREAKER in the OFF position; then stop the unit (par. 26) and proceed as follows:

(1) Check the fuel supply, engine coolant level, and engine oil level. Replenish as required.

Caution: If it is necessary to add coolant to a hot engine, restart the unit and slowly add the coolant while the engine is running at idle speed under no load.

(2) Examine all fittings, connections, and gaskets for evidence of leakage.

(3) Inspect the condition of the wiring and check all electrical connections.

(4) Check the entire unit to be sure the equipment is in proper operational order.

d. After Operation. Perform the services as instructed in subparagraph *c* above. Then proceed as follows:

(1) Wipe the unit clean as required.

(2) Perform the daily lubrication services as instructed in paragraph 36*b* and as indicated on the lubrication chart (fig. 17).

(3) Add water to the batteries, if necessary.

(4) Correct or report any troubles developed during operation.

(5) Clean all tools and stow them properly.

(6) Perform any function necessary to ready the unit for the next operation.

42. Weekly Maintenance Services

For purposes of the following instructions, a weekly maintenance period is considered to be 64 operating hours. Perform all daily maintenance and lubrication services as instructed in paragraph 41 and in the lubrication chart (fig. 17). Perform all other weekly services as specified in the W (weekly) column on DA Form 464 (par. 46). Make appropriate entries on the form to indicate the services actually performed and repairs or additional services required.

43. Monthly Maintenance Services

For purposes of the following instructions, a monthly maintenance period is considered to be 256 operating hours. Perform all daily and weekly maintenance and lubrication services as instructed in paragraphs 41 and 42 and in the lubrication chart (fig. 17). Perform all other monthly services as specified in the M (monthly) column on DA Form 464 (par. 46). Make appropriate entries on the form.

44. Semiannual Maintenance Services

For purposes of the following instructions, a semiannual maintenance period is considered to be 1,024 operating hours. Perform all daily, weekly, and monthly maintenance and lubrication services as instructed in paragraphs 41, 42, and 43 and in the lubrication chart (fig. 17). Perform all other semiannual services as specified in the TI (technical inspection) column on DA Form 464 (par. 46). Make appropriate entries on the form.

45. Annual Maintenance Services

For purposes of the following instructions, an annual maintenance period is considered to be 2,048 operating hours. Perform all daily, weekly, monthly, and semiannual maintenance and lubrication services as instructed in paragraphs 41, 42, 43, and 44 and in the lubrication chart (fig. 17). Perform all other annual services as specified in the TI column on DA Form 464 (par. 46). Make appropriate entries on the form.

Note. Instructions for general repair and overhaul of Power Unit PU–26A/U are given in chapter 4.

46. DA Form 464 Services

DA Form 464 (Work Sheet for Preventive Maintenance and Technical Inspection of Engineer Equipment) is provided as a guide in the performance of necessary periodic services and inspections. Make appropriate entries on this form whenever any of the operations listed are performed. The following are detailed instructions for items on DA Form 464 which apply to Power Unit PU–26A/U.

TI	M	W	Action
----------	S	S	1. *Before-Operation Services.* Perform all before-operation services as instructed in paragraph 41*a*.
----------	L	L	2. *Lubrication.* Lubricate the unit as instructed in paragraph 36*b* and in accordance with the lubrication chart (fig. 17).

TI	M	W	Action
----------	C	C	3. *Tools and Equipment.* See that all tools, spare parts, and equipment are present by checking with the packing list on the unit or the tables in paragraph 8*b*, *c*, *d*, and *e*. Examine the condition of the tools and clean them and the tool trays thoroughly. Stow the tools properly.
(*)	(*)	(*)	4. *Fire Extinguisher.* Inspect the condition of the fire extinguisher. See that it is fully charged.
----------	(*)	(*)	5. *Publications.* An adequate supply of DA Forms 11–260, 11–261, and DA Form 464 should be available. The manual for the equipment and other required publications should be present and in legible condition.
(*)	(*)	(*)	6. *Appearance.* Examine the entire unit for damage to the finish. Remove all traces of rust and dirt. If necessary, refer to paragraph 39 and refinish as instructed.
(*)	(*)	(*)	7. *Modifications.* See that all modification work orders and other directives have been completed.
(*)	(*)	(*)	8. *Noise and Vibration.* (Enter this item on DA Form 464.) While operating the unit, with or without load, be alert for any unusual noises which may indicate trouble. Also, listen for any excessive vibrations which may indicate loose or damaged parts or inadequate lubrication.
			ENGINE AND ACCESSORIES
----------	(*)	(*)	11. *Cylinder Head, Manifold, and Gaskets.* Check the cylinder head and exhaust manifold for cracks. Examine for coolant, oil, and compression leaks around the cylinder head gasket and stud nuts. See that the manifold nuts are secure. Check the cylinder head stud nuts for tightness. Use a torque wrench and tighten each nut to a tension of 60–65 foot-pounds in the sequence shown in figure 63.
(*)	A	----------	12. *Valve Mechanism.* Remove the valve spring cover and examine the valve mechanism as follows: Remove the metal tube leading from the heat exchanger to the intake manifold. Disconnect the breather tube and oil hose connected to the valve spring cover. When disconnecting the oil hose, a small amount of oil from the engine-speed governor will be released. Use a small can to catch the oil. Remove the cover. See that the valve tappets and springs are in good condition and well-lubricated. Check and, if necessary, adjust all valves to a clearance of .016 inch as instructed in paragraph 62*c*. When replacing the cover be sure it is oil tight.
(*)	----------	----------	13. *Compression Test.* Before testing the engine for compression, allow the unit to run until normal operating temperature is reached. Remove all the spark plugs and hold a compression gage firmly in the spark plug hole of No. 1 cylinder. Push the manual choke and manual throttle controls in all the way. Turn the engine with the starting motor until the maximum compression reading is shown on the compression gage. This usually necessitates about 10 revolutions of the engine. Record the reading in the space provided on Form 464. Perform the test on the remaining three cylinders. The standard compression for the engine is 111 psi. Satisfactory engine performance cannot be expected if the compression is below 70 psi or if the reading varies more than 10 pounds between the cylinders. Refer to the troubleshooting chart (par. 49) to determine the cause and remedy for low or variant engine compression readings.
----------	(*)	(*)	14. *Crankcase, Breathers.* With the engine running at idle speed, check the oil pan, gear cover, and valve spring cover for oil leaks. Change oil as instructed in paragraph 36*b* (1) and in the lubrication chart (fig. 17).
C	----------	----------	*Clean.* Semiannually, clean the crankcase ventilating control valve thoroughly in cleaning solvent. Be sure all carbon and sludge is removed from the valve and from inside of the valve housing. *Note.* To disassemble the valve, a great deal of pressure must be applied to both hexagonal sections of the valve housing.. During reassembly, be sure the housing is airtight.
----------	(*)	(*)	15. *Oil Filters, Oil Coolers.* Examine the oil filter, oil lines, and connections for evidence of leakage. Drain the oil in the filter whenever the crankcase oil is changed (par. 36*b* (1) and fig. 17).

TI	M	W	Action
(*)	S	S	*16. Radiator.* Inspect the radiator core and hoses for evidence of leakage. See that the hoses are in good condition and tight. Be sure the radiator is mounted securely. Check the air passages in the core for such obstructions as dirt, insects, and other foreign matter. Remove the obstructions in the core with a stream of compressed air. Examine the coolant for rust or other foreign matter. Test the antifreeze and note in the space provided the lowest temperature to which the unit is protected.
C	C	----	*Clean.* If the coolant is badly contaminated, clean the system in accordance with current directives.
(*)	(*)	----	*17. Water Pump, Fan, Shroud.* Inspect the water pump for evidence of leakage. Tighten the pump mounting bolts. Check the fan blades for nicks and for other signs of damage. Tighten the bolts securing the fan to the pulley.
(*)	(*)	(*)	*18. Belts and Pulleys.* See that the drive pulleys are in good condition and are mounted securely. Examine the two drive belts for evidence of deterioration, wear, and fraying.
A	A	A	*Adjust.* Adjust the engine speed governor drive belt for about 1-inch deflection. Adjust the fan belt for about 1-inch deflection midway between the fan and idler pulleys.
(*)	(*)	----	*19. Oil Pump, Pressure Relief Valve.* The oil pump will usually require no attention except during major overhaul of the engine (ch. 4). In normal operation the oil pressure should be 15 psi to 25 psi. Check the oil pressure on the oil-pressure gage and record the reading in the appropriate space on Form 464. The oil-pressure relief valve is an integral part of the oil pump and also requires little attention. However, if it is necessary to adjust the pressure by means of the relief valve, refer to paragraph 25*b*(6) and proceed as instructed.
(*)	(*)	----	*20. Governor and Linkage.* Examine the engine-speed governor throttle linkage for any evidence of binding and for wear. See that the linkage is secured properly and operating freely. Once a year (after 2,048 operating hrs.) disassemble, clean, and inspect the governor as instructed in paragraph 54*a*.
----	L	----	*Lubricate.* Lubricate the throttle linkage as instructed in paragraph 36*b*(6) and in the lubrication chart (fig. 17).
(*)	----	----	*21. Overspeed Safety Governor.* (Enter this item on DA Form 464.) Check the performance of the overspeed safety governor as follows: Remove the bearing cover from the generator end bell and place a tachometer against the rotor shaft. Disconnect the carburetor-to-governor throttle linkage. After the engine reaches normal operating temperature, slowly open the throttle. Note the reading of the tachometer at the time the overspeed governor takes control. The governor should cut in at approximately 2,100 rpm. If adjustment is necessary, refer to paragraph 62*e* and proceed as instructed. *Note.* When checking the performance of the overspeed governor, the engine must be in good mechanical condition.
----	----	----	*22. Vacuum Test.* (Enter this item on DA Form 464.) Disconnect the igniter assembly air hose from the tee fittings in the intake manifold. Connect a vacuum gage to the fitting. Be sure the connection is tight. Start the engine and allow it to run until normal operating temperature is reached. With the unit running at a load speed (1,800 rpm) at an altitude between sea level and 2,000 feet, the vacuum gage should indicate not less than 16 inches of mercury at no load. At higher altitudes deduct 1 inch vacuum for each 1,000 feet of increased altitude. Refer to the troubleshooting chart (par. 49) to determine the cause and remedy for abnormal vacuum indications.
			FUEL SYSTEM
----	----	(*)	*38. Fuel Pumps and Housing.* See that all connections on the engine fuel pump are well-secured and tight. Note any evidence of leakage.
C	----	----	*Clean.* Clean the filter bowl and screen as instructed in paragraph 36*b*(5).
----	(*)	(*)	*39. Carburetor and Linkage.* Examine the carburetor throttle housing gasket, bowl cover gasket, fuel inlet line, and all jets for evidence of leakage. See that the carburetor is mounted securely. Check all the linkage for free operation.

TI	M	W	Action
----	(*)	(*)	*40. Filters.* Check the fuel filter and fittings for evidence of leakage.
----	C	----	*Clean.* Clean the filter element as instructed in paragraph 36*b*(4).
----	(*)	(*)	*41. Air Cleaners and Precleaners.* See that the air cleaner hoses are well-secured and in good condition.
----	CS	CS	*Clean and Service.* Clean and service the air cleaner as instructed in paragraph 36*b*(2) and in the ulbrication chart (fig. 17).
(*)	(*)	(*)	*44. Fuel Lines.* Carefully examine all fuel lines and fittings for evidence of leakage and damage. See that all connections are tight.
			ELECTRIC SYSTEM
(*)	(*)	----	*46. Spark Plugs.* Check for leakage around the spark plug gaskets. Remove the spark plugs and examine for cracked insulation, excessive carbon deposits, and electrode erosion.
C	C	----	*Clean.* If necessary, clean off carbon deposits by applying an abrasive to the plugs for not more than 3 seconds. Prolonged use of abrasive wil lwear away the insulator and electrodes. Use an air blast to remove loose particles of abrasive. Inspect the spark plug again for cracked insulation. If no spark plug cleaner is available, install new or reconditioned plugs.
A	A	----	*Adjust.* Measure the spark gap and adjust to .030 inch.
----	CS	CS	*47. Battery.* Examine the batteries for cracks and for evidence of leakage. Clean corrosion off the battery terminal posts and cable terminals and lubricate with a light coat of grease (WB). Make sure the cable terminals are well-secured and are making good contact with the battery posts. Check the level of the electrolyte. The level should be one-half inch above the separators. If the electrolyte is below this level, add distilled water. Test the voltage of each cell and record the readings on Form 464. Each cell should measure 2 volts, or slightly more. Refer to paragraph 17 and test the specific gravity of each cell as instructed. Record readings on Form 464.
(*)	(*)	----	*48. Starter.* See that the starting motor is mounted securely and that all cable connections are clean and tight. Check the brushes for free movement in the holders. Examine the brushes for wear and replace them if they are worn to two-thirds their original length. To replace the brushes, first remove the starter and commutator end plate. Remove the old brushes by melting the soldered connections. Solder the new brush cables to the terminals and slip the brushes into the holders. Replace the end plate. Refer to paragraph 54*i*(3) and seat-in the brushes as instructed. Check the brush spring tension with a spring scale as instructed in paragraph 54*i*(2).
C	C	----	*Clean.* If the brushes have been arcing, as evidenced by a dirty commutator, clean the commutator with fine sandpaper (No. 0000). Blow out the sand with compressed air and seat-in the brushes. If the commutator is dirty or worn to the extent that sandpaper will not clean it, refer to paragraph 54*i*(2) and turn it down in a lathe as instructed.
(*)	(*)	----	*49. Distributor or Magneto.* The distributor is incorporated in the igniter assembly. Examine the distributor cap for cracks, carbon, and evidence of arcing. Replace the cap if any of these conditions exist. Clean high-tension terminals if corroded. Inspect the rotor for cracks and for evidence of excessive burning at the end of the contact strip. Replace the rotor if any of these conditions are found. Check the capacitor lead for damaged insulation and broken wires. See that the capacitor is well-mounted and the terminal post connections are tight. Test the capacitor with a conventional capacitor tester. Capacitance should be from .18 to .21 μf (microfarad). Examine the contact points. They should be clean and not burned or pitted. If only slightly pitted or burned, resurface the points with the dresser furnished with the unit. If badly pitted or burned, replace the points.
A	A	----	*Adjust.* Adjust the contact point gap to .020 inch.
L	L	----	*Lubricate.* Lubricate the distributor in accordance with instruction in paragraph 36*b*(8) and in the lubrication chart (fig. 17).

TI	M	W	Action
(*)	(*)	----------	*50. Coil, Wiring, Switches.* See that the ignition coil, incorporated in the igniter assembly, is mounted securely and that the cables are in good condition. Examine all wiring for poor connections and worn insulation. Check all switches for correct connections and mountings and for proper operation.
(*)	----------	----------	*53. High-Coolant-Temperature Cutoff Switch.* (Enter this item on DA Form 464.) Check the accuracy of the cutoff switch as follows: Insert a thermometer in the upper tank of the radiator. Set the dial of the cut-off switch at 220° F. Cover the radiator and start the engine. When the temperature exceeds 180° F, slowly move the dial counterclockwise until the engine shuts off. The reading on the dial should coincide with the thermometer reading. If the readings differ considerably, adjustment is necessary.
A	----------	----------	*Adjust.* Adjust the cutoff switch as follows: Loosen the two screws in the dial. Be careful not to disturb the dial setting. With the screws loose, break the seal on the dial scale and set the scale to corerspond with the thermometer reading just taken. Tighten the screws and retest. ***Caution:*** The factory setting of the dial scale is sealed with compound on both the scale and the central disk of the dial. Do not break this seal except during adjustment.
(*)	----------	----------	*54. Low-Oil-Pressure Cutoff Switch.* (Enter this item on DA Form 464.) Test the accuracy of the cutoff switch as follows: Remove the switch from the engine. With a pressure regulating valve, pressure gage, and a continuity tester, check the pressure at which the switch opens. If the pressure is above or below 5 psi (plus or minus 1 psi), replace the switch.
			CONTROL SYSTEM
(*)	(*)	(*)	*57. Gages.* Observe the oil-pressure gage and coolant-temperature gage for correct readings. Refer to paragraph 20*a* for normal gage indications. Investigate any abnormal reading.
(*)	(*)	(*)	*58. Meters.* Observe the d-c ammeter, a-c ammeter, voltmeter, and frequency meter for correct readings. Refer to paragraph 20 for normal meter indications. Investigate any abnormal reading.
			FRAMES AND MOUNTINGS
(*)	(*)	----------	*80. Frame.* Examine the upper and lower frame for warpage and for cracks around the welds.
(*)	(*)	----------	*84. Mountings.* (Enter this item on DA Form 464.) See that the engine and generator mounting bolts are tight. Examine the condition of the shock mounts.
			MISCELLANEOUS ITEMS
(*)	(*)	----------	*133. Radio Frequency Suppression Equipment.* (Enter this item on DA Form 464.) Inspect the condition of all the radio frequency suppression equipment. Make sure that all bonding straps, capacitors, and external-internal-toothed lock washers are well-secured. Refer to paragraph 65 for suppression equipment details.
			GENERATORS
(*)	(*)	----------	*172. Armature, Commutator, Slip Rings.* Blow all carbon dust and other foreign matter from the brush rigging, exciter armature, and field ring. Check the brushes for wear and for free movement in the holders. Replace the brushes if worn to less than one-half inch in length. (Refer to paragraph 56*a*(7), (8) and replace and seat-in the brushes as instructed.) Check the brush spring tension with a spring scale as instructed in paragraph 56*a*(7). Examine the surfaces of the commutator and slip rings for evidence of brush-arcing, pits, dirt, extensive discoloration, and wear. If necessary, clean the commutator and slip rings with No. 0000 sandpaper. Blow out the sand with compressed air and seat-in the brushes. If the sandpaper will not clean the commutator or slip rings, refer to paragraph 56*d*(5) and turn them down on a lathe as instructed.
(*)	(*)	----------	*173. Controls, Switch Gear, Wiring.* *Circuit Breaker.* See that the circuit breaker is tightly secured to the control panel. Examine the condition of all connections.

This movement is transmitted through the connecting rod to the crank shaft, which converts the reciprocating motion to rotary motion.

(4) *Exhaust stroke.* The exhaust valve, is operated by a tappet in contact with the crankshaft. The exhaust valve opens 47° before bottom dead center and permits the upward travel of the piston to expel the exhaust gases through the exhaust port in the engine, into the exhaust manifold, and then into the muffler. As the piston approaches top dead center, the intake valve again starts to open, the exhaust valve starts to close, and a new cycle is under way.

b. Engine-Speed Governor (fig. 25). The engine-speed governor is of the flyball type, belt-driven from a pulley on the engine crankshaft. The centrifugal force of the revolving flyballs is transmitted by a pivoted yoke to lateral motion which acts against the tension of the governor spring. This action also moves the carburetor throttle towards closed position. When the predetermined speed setting is reached, the governor closes the throttle to a position which maintains constant engine speed. The governor is set to hold the engine speed at 1,800 rpm which is the synchronous speed for 60-cycle operation. Governor adjustments are described in paragraph 25*b*. The engine lubrication system supplies engine oil to the governor for continuous lubrication.

c. Engine Overspeed Safety Governor (fig. 27). The velocity-type overspeed safety governor is installed between the carburetor and intake manifold specifically to guard against engine and generator damage due to failure of the engine speed governor or its drive belt. In normal operation, a spring within the governor holds the governor throttle plate open. If the engine starts to run-away, the velocity of the fuel mixture from the carburetor becomes great enough to close the governor throttle plate as far as the tension of the governor overspeed spring will permit. This spring tension is set and sealed at the factory so that the governor will take control of the engine at approximately 2,100 rpm. To check and adjust the overspeed governor, refer to paragraphs 46 and 62*e* and proceed as instructed.

d. Cooling System (fig. 19). The engine coolant is circulated upward through the jacketed passages around the cylinders, valve ports, and combustion chambers. It then flows from the cylinder head through hose connections to the top of the radiator, then downward through the radiator, where it is cooled by the air blast of the fan. The coolant is then pumped back into and through the cylinder block. When clean, the system is capable of maintaining the temperature of the coolant (measured at the engine outlet elbow) at least 10°F. below the boiling point for water at the system pressure when operating under full load in ambient temperature up to 125°F. A 180°F. thermostat keeps the coolant from circulating through the radiator until normal operating temperature has been attained. The high-temperature cutoff switch mounted on the water outlet elbow automatically opens the ignition circuit and stops the engine if the coolant temperature reaches the predetermined setting. The pressure in the system must exceed 4 psi before the pressure cap will release vapor through the radiator overflow.

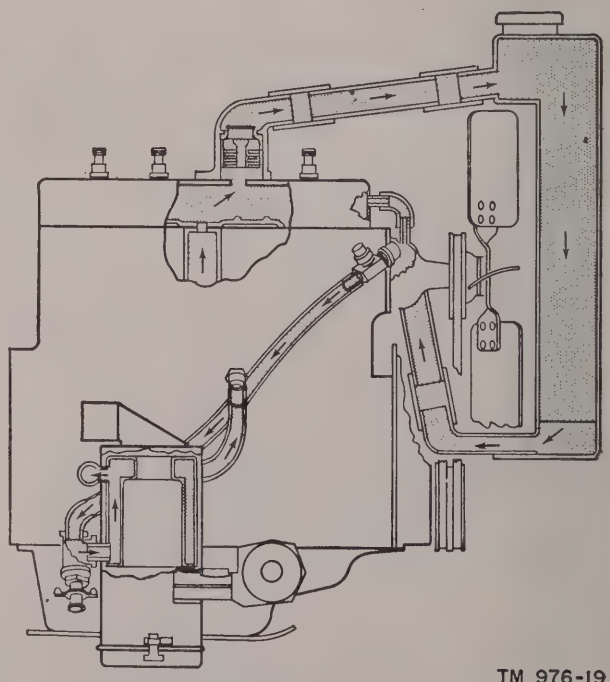


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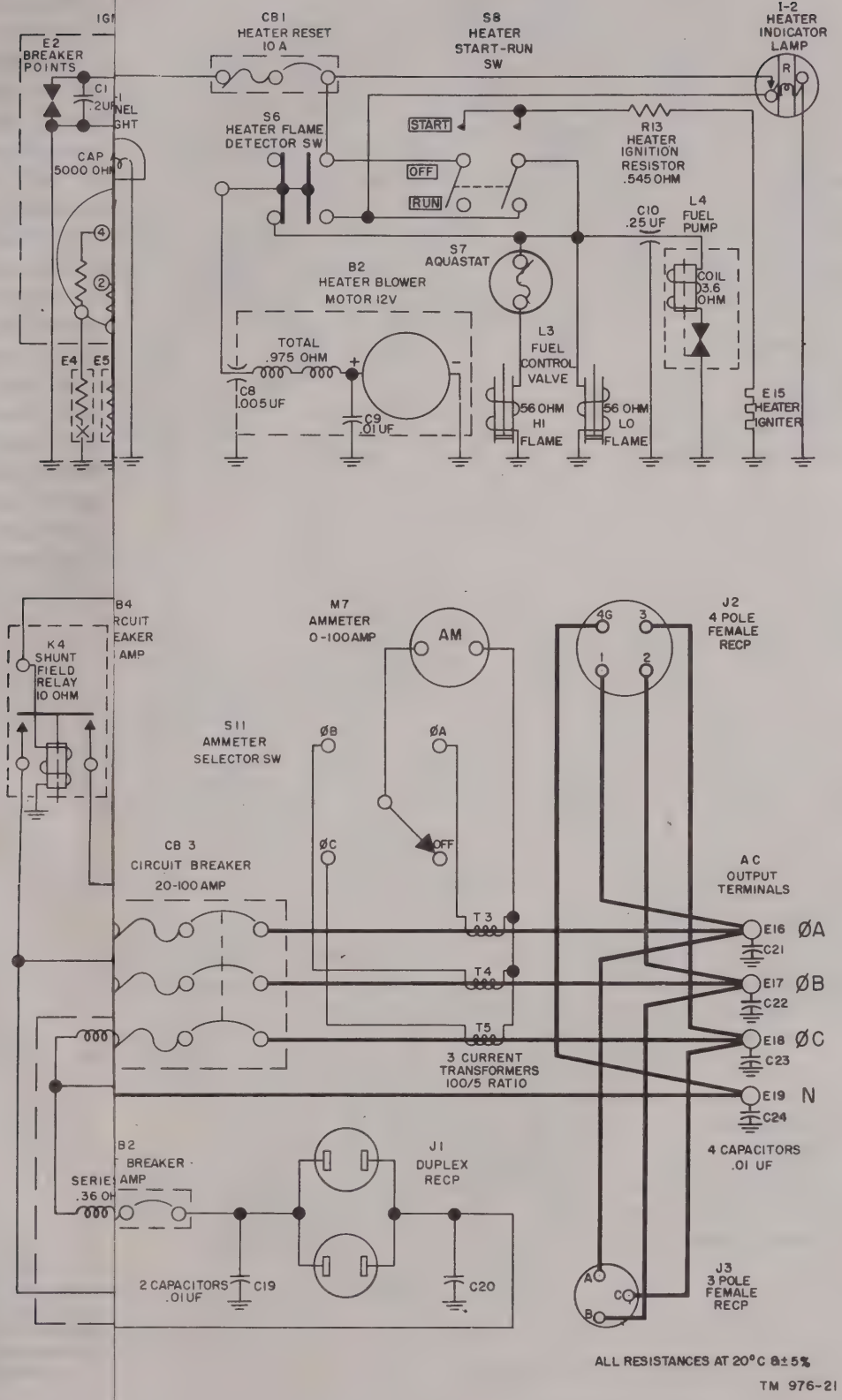
Figure 19. Coolant system flow diagram.



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This movement is transmitted through the connecting rod to the crank shaft, which converts the reciprocating motion to rotary motion.

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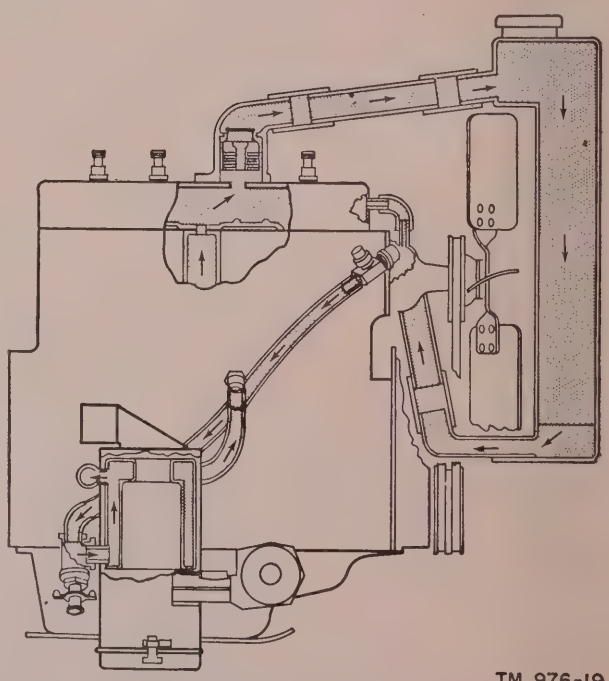

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Figure 19. Coolant system flow diagram.

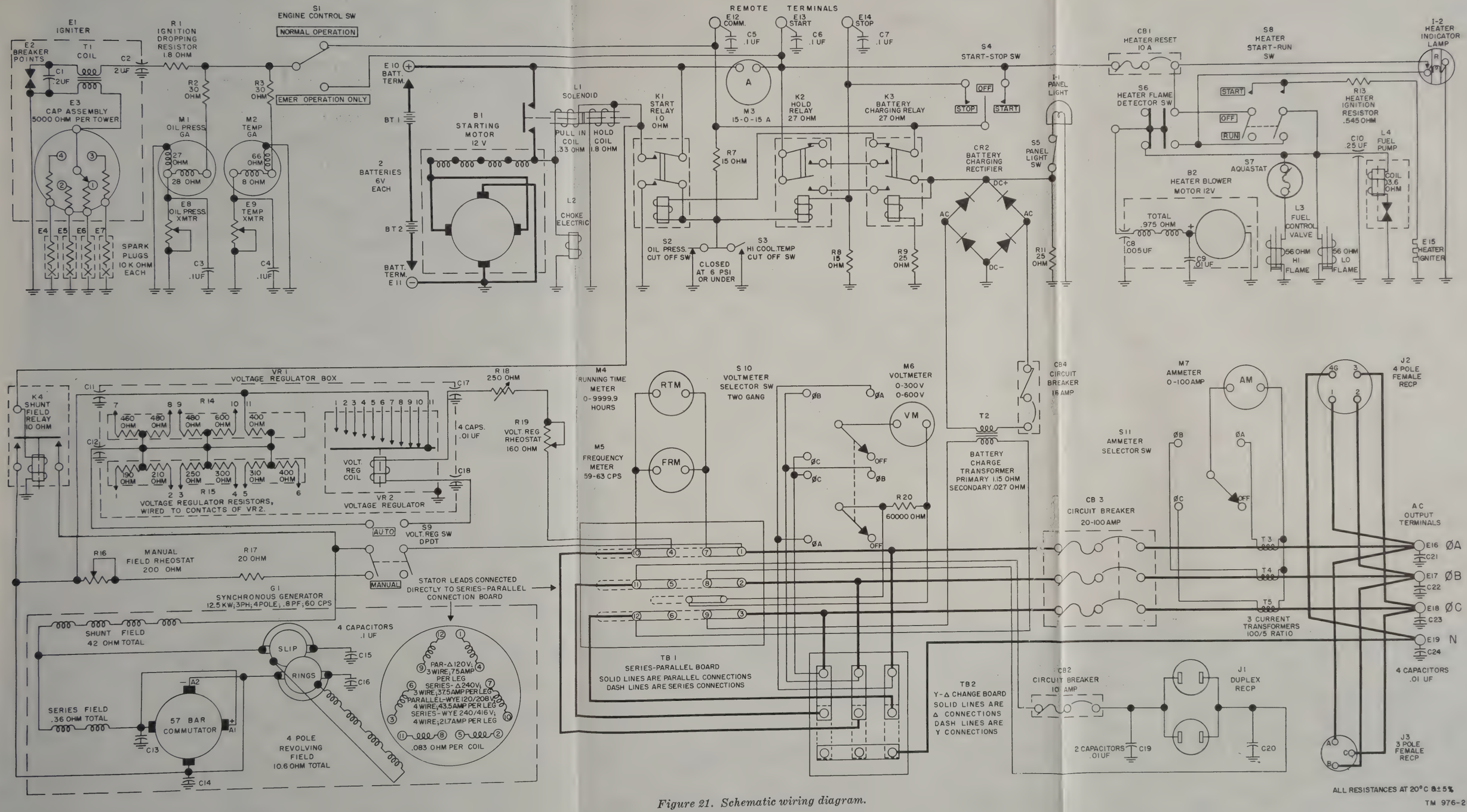
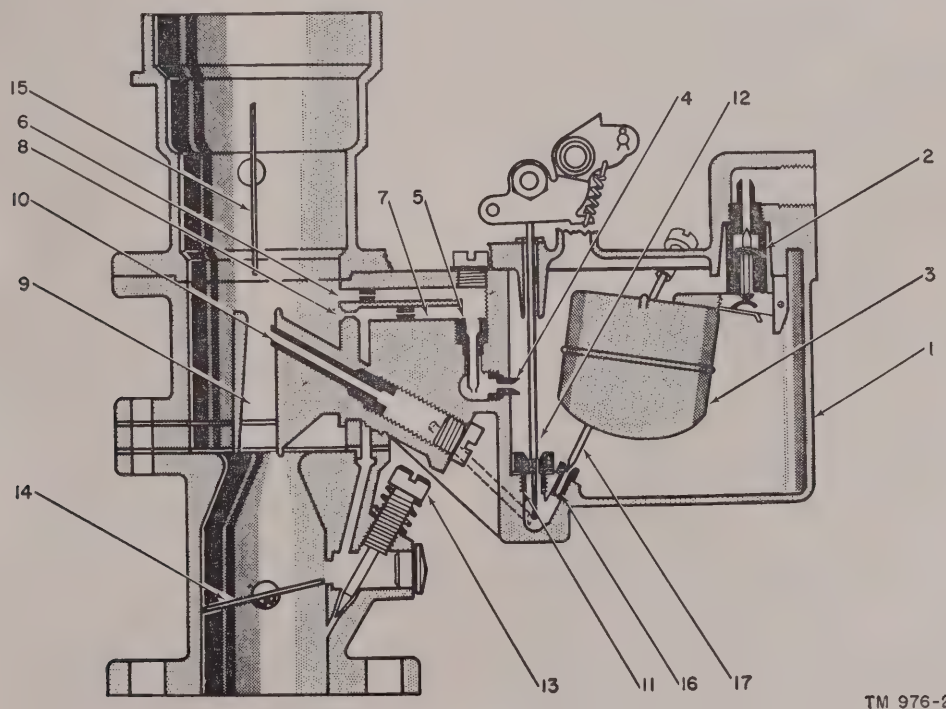


Figure 21. Schematic wiring diagram.

e. Fuel System. The unit operates on fuel pumped from an external supply tank through the auxiliary fuel line. The fuel enters a disk-type filter and is pumped to the carburetor by a diaphragm-type pump (fig. 27). The diaphragm is actuated by the engine camshaft through a rocker arm (13) on the fuel pump. The rocker arm pulls the diaphragm (16) downward; this reduces the pressure within the pump chamber and creates a suction on the inlet. Fuel flows upward to the sediment bowl (2), through the strainer screen (4) and the inlet check valve (10), into the pump chamber. On the discharge stroke, the diaphragm spring pressure pushes the diaphragm upward, forcing fuel from the pump chamber, through the outlet check valve (9), and into the carburetor float bowl. The diaphragm is pulled downward by the camshaft and rocker arm and upward by the spring pressure until the carburetor bowl becomes full. The back pressure of fuel in the pump holds the diaphragm down, and it remains in this position until the lack of fuel in the carburetor float chamber permits operation of the pump. The fuel enters the carburetor bowl (1, fig. 20) through the float-operated needle valve assembly (2); the quantity of fuel is governed by the float (3). At idling speeds and light-load operation, fuel flows through the idle well jet (4) and the low speed jet (5), where it combines with air entering through the bypass (6). The fuel breaks up into a vapor and continues on through the economizer (7) and is combined with more air from the lower bleed (8). The mixture is richer than required, but with air from the venturi (9) a suitable mixture for the engine is obtained. At rated full-load speeds, the velocity of air flowing through the carburetor venturi creates pressure at the tip of the main nozzle (10). The pressure causes fuel to flow from the bowl through the metering jet (11) and out of the main nozzle into the carburetor venturi. At high speeds, the area of the opening between the metering rod (12) and its jet governs the amount of fuel



1 Bowl
2 Needle-valve assembly (H68)
3 Float (O 44)
4 Idle-well jet (H81)
5 Low-speed jet (H74)
6 Bypass
7 Economizer
8 Lower bleed
9 Venturi
10 Main nozzle
11 Metering jet
12 Metering rod (H73)
13 Idle-adjustment screw (H90)
14 Throttle valve (O 49)
15 Choke valve (O 40)
16 Altitude jet
17 Altitude-adjusting needle (H72)

Figure 20. Carburetor functional diagram.

entering the engine. The metering rod is controlled by the throttle.

f. Starting System (fig. 21).

(1) *Normal operation (automatic start).* With the engine control switch in the NORMAL OPERATION position and the START-STOP switch in the START position, the ignition circuit is energized. At the same time, the coil of start relay K1 is energized through the normally closed contacts of the battery-charging relay K3 and the closed contact of the oil-pressure cutoff switch to ground. Relay K1 immediately pulls in and closes its two sets of normally open contacts. In closing, one set of contacts energizes the starting circuit by providing a closed circuit for the start solenoid L1 (accomplished by energizing the *pull-in* (series) coil through the low resistance path of the starting motor). Energizing of the series coil of the start solenoid draws the pinion into engagement with the flywheel ring gear. With complete engagement of the pinion and ring gear, the main contact of the start solenoid closes, shorts out the series coil, and energizes the starting motor, which cranks the engine. During the cranking time, the start solenoid remains energized through its *hold* (shunt) coil. At the same time the starting motor is energized, the automatic choke becomes energized. The second set of contacts on relay K1 are in parallel with the oil-pressure cutoff switch, and, in closing, enables the starting motor to continue cranking the engine after the oil pressure cutoff switch has opened. If the START-STOP switch is released at this point, the coil of relay K1 will be de-energized, causing the pinion to disengage. The pinion will not re-engage with the ring gear until the oil-pressure cutoff switch closes (oil pressure drops below 5 psi, plus or minus 1 psi). As the engine starts, the overriding clutch between the pinion and starter shaft prevents starter damage due to overspeed. At the same time the series coil of the start solenoid L1 is energized (through the closing of one set of contacts on relay K1), the coil of shunt field relay K4 is energized, closing its set of normally open contacts. The closing of this set of contacts shorts out all external resistance in the exciter shunt field circuit, thus permitting a rapid build-up of the exciter voltage during the initial engine starting phase. When the engine speed reaches approximately 1,000 rpm, the exciter voltage is of sufficient value to provide an adequate current to the rotating field of the main generator. This enables the main generator voltage to reach a satisfactory value for operation of the battery-charging rectifier through the battery-charging transformer and circuit breaker CB4. The d-c output of the battery-charging rectifier then reaches a sufficient value to actuate relay K3. (The START-STOP switch must be held in the START position during the entire cranking cycle.) Simultaneously, when relay K3 closes, relay K1 opens, and the hold relay K2 closes. As a result of relay K1 opening the cranking circuit opens and the pinion is pulled back in release position by spring pressure on the start solenoid armature. With the opening of relay K1, relay K4 also opens, thereby permitting any external resistance of the exciter shunt field circuit to be now introduced to control the generator. After relay K2 has been initially closed, its coil is kept energized by feeding current from the positive side of the rectifier (d-c +) through one set of closed contacts on relay K3, through one set of closed contacts on relay K2, then through a second set of closed contacts on relay K2 and a second set of closed contacts on relay K3, through resistor R7, through the coil of relay K2, through

resistor R8 to ground. With relay K2 held in closed position, the ignition circuit is energized through the closed contacts on relays K2 and K3. (The START-STOP switch now may be released. If operating from a remote location, the START-STOP switch at the remote point may not be released until there is an indication of full generator rated voltage.)

Note. The starter will not be released automatically unless the battery charging circuit breaker is in the ON position.

(2) *Emergency operation (manual start).* With the engine control switch in the EMERGENCY OPERATION ONLY position and the engine being hand cranked, current is supplied direct from the batteries to the ignition circuit, bypassing all the relays and the protective circuits. In order to have the battery-charging and safety circuits function properly while the engine is running, the START-STOP switch must be pressed momentarily in the START position and the engine control switch must be returned to the NORMAL OPERATION position. This sets the relays in the run position. At this point, also, the unit can be run without the batteries, if necessary, and still be under the protection of the safety cutoff switches.

(3) *Stopping.* With the engine control switch in the NORMAL OPERATION position, momentarily press the START-STOP switch in the STOP position. This will short-out the coil of relay K2 (resistor R8 prevents short-circuiting of the battery) and cause its contacts to return to their normally open position. One set of contacts will open the ignition circuit and the second set of contacts will open the battery-charging circuit, thus stopping the unit. As the engine slows down, the battery-charging voltage decreases and relay K3 returns to its normal position. The oil-pressure cutoff switch closes after the engine has completely stopped. If the START-STOP switch is accidentally pushed into the START position before the engine completely stops, the safety circuits prevent energizing of the start solenoid. This eliminates the danger of damaging the flywheel ring gear and the starter pinion gear.

(4) *Coolant-temperature and oil-pressure cutoff switches.* In the event that either the coolant temperature exceeds the setting on the switch dial or the oil pressure falls below 5 psi, plus or minus 1 psi, the respective switches will function and short-out the coil on relay K2 (resistor R8 prevents short-circuiting of the battery). This will open the contacts of the relays, thus opening the ignition and battery-charging circuits, and cause the unit to stop. The unit then will not operate in the NORMAL OPERATION position until the cause of the failure is corrected. The unit will, however, run in the EMERGENCY OPERATION ONLY position because the safety switches are then bypassed.

g. Lubrication System. The gear-type rotary oil pump is located externally on the right side of the engine. The pump is driven by a spiral gear on the engine camshaft and draws oil from the crankcase through a floating oil intake. The float and screen assembly is so constructed that it remains on top of the oil, raising and lowering with the oil level. The oil, therefore, is drawn from the top surface, leaving any accumulation of water and dirt in the bottom of the pan. Oil is forced to the crankshaft and the camshaft bearings through drilled passages in the cylinder block webs and then to the connecting rod bearings through drilled passages in the crankshaft. A drilled passage in the crankshaft, from the front bearing to holes in the crankshaft sprocket, provides positive lubrication for the timing gears through a jet. Direct spray from the connecting rod bearings lubricates the cylinder walls, pistons, piston pins, and the valve mechanism. The oil is forced through the disk-type oil filter from the outlet line on the right side of the crankcase. The oil enters the filter bowl and passes through a stack of disks

and spacers to the outlet. Dirt and solids lodge against the disks and the clean oil passes through. At the filter outlet, the oil is diverted in two directions. A small portion travels through the engine speed governor, into the valve spring cover and back to the crankcase. The remaining oil, leaving the filter, is conducted to the timing gear cover and then down to the crankcase. If the oil pressure drops below a safe minimum of 5 psi, plus or minus 1 psi, the low-oil-pressure cutoff switch opens the ignition circuit and stops the engine.

h. Generator. When the engine of Power Unit PU–26A/U is started, the exciter armature of the generator sweeps across the stationary exciter field poles. Residual magnetism in the exciter field creates magnetic flux which leaves each field pole and passes into the exciter armature. The exciter armature conductors sweep across field poles of alternate polarity, cutting the lines of flux. Alternating current is thereby induced in the conductors. These conductors are connected to a commutator consisting of a number of copper segments insulated from each other. Brushes slide on the surface of these segments. At the instant a conductor goes through the neutral plane, the current reverses; at the same instant, the segments switch the brush connections. Thus, the commutator rectifies the generated alternating current, delivering direct current through the brushes to the exciter field and slip rings. The current delivered to the exciter field increases the field strength which, in turn, greatly increases the voltage induced in the conductors. The exciter voltage thus builds up to normal value. The greater portion of the exciter output is used to excite the alternator revolving field. The direct current is delivered from the commutator brushes through the slip ring brushes to the alternator field coils. The field is magnetized with the poles having alternate north and south polarity around the circumference. The revolving electromagnetic field sweeps across the stator windings. As the lines of flux cut the stator conductors, alternating current is induced in each separate stator winding. The windings are spaced 120° apart, thus 3-phase alternating-current output is produced. A voltage regulator is used to control the amount of resistance in the exciter field circuit. A constant line voltage is thereby maintained over the entire load range. Essentially, the regulator acts as an automatic field rheostat which adjusts the field current of the generator to provide proper excitation for all normal load conditions. The regulator consists of three elements: a voltage sensitive solenoid, a contact finger assembly, and a set of control resistors. The voltage sensitive solenoid consists of a magnetic coil and a magnet circuit closed through a moving armature, which is connected to a push bar. The lower edge of the push bar is biased so that the fingers, which are set approximately parallel to the base, are pushed off their contacts one at a time in sequence. These fingers, in turn, are connected to pins which plug into corresponding socket terminals. (These elements are shown in fig. 22.) From these terminals, wires lead to the control resistors. The operation of the regulator is not affected appreciably by changes in ambient conditions or by vibration or shock. The regulator's characteristics are independent of the position in which it is mounted so that the regulated voltage will not change if the regulator is moved. The regulator acts as an automatic field rheostat which adjusts field current in order to maintain constant output voltage of the generator. The contact fingers of the regulator rest on the shorting contact bar when the coil is not energized, reducing the resistance in the field circuit to a minimum. When the magnet coil is energized, the moving armature is attracted to it. This movement is opposed by the reference springs and the armature moves only when the magnetic pull and the pull of the springs are not equal. As the armature moves, it opens or closes fingers, depending on the direction of motion, increasing or reducing the amount of resistance in the field circuit and thus maintaining a constant output voltage. If the generator is operating at rated voltage with full load, the regulator is in equilibrium with a certain amount of resistance in the field circuit. Should the load suddenly be removed, the output voltage would tend to rise, increasing the coil voltage and moving the armature toward the core. This action would open more fingers and insert more resistance in the field circuit, reducing field current and

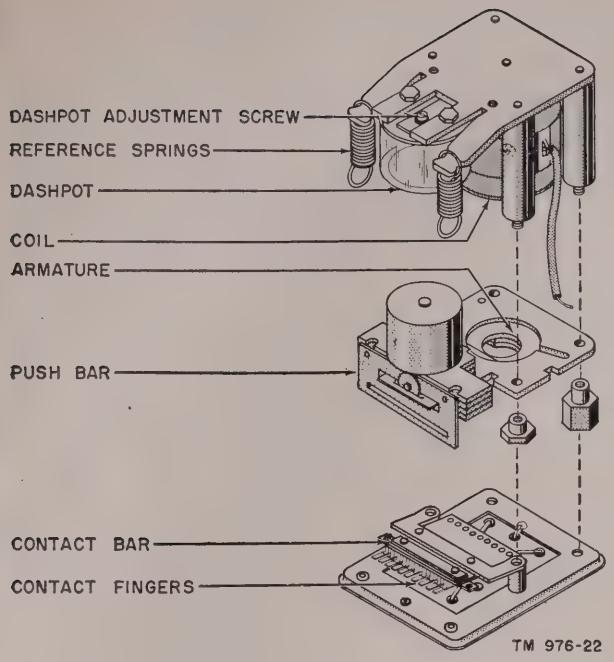


Figure 22. Voltage regulator, exploded view.

restoring output voltage to its original value. The reference springs and the contact fingers are set at the factory. No adjustment of these parts should be made in the field. It is the action of the finger and solenoid combination with this factory-set characteristic that makes the regulator a sensitive voltage controller. The regulator is inherently very fast acting. Stabilization is accomplished through the use of an air dashpot which can be adjusted to match the time constant of the generator and give optimum speed of response without hunting.

i. Winterization System. Incorporated within the unit is a winterization system designed to preheat the engine crankcase oil, coolant, and intake manifold for ease in starting in arctic conditions. The gasoline-burning, semiautomatic heater has an input capacity of 32,000 Btu (British thermal unit) per hour on *high fire* and 14,000 Btu per hour on *low fire*. The heater will start quickly under all temperature conditions to —65°F.

(1) *Air system* (fig. 23).

(a) Blower and motor. A paddle-wheel-type blower mounted to a 12-volt motor supplies both the combustion air and the air for diluting the burned gases. The blower motor must turn at least 5,000 rpm to provide satisfactory combustion.

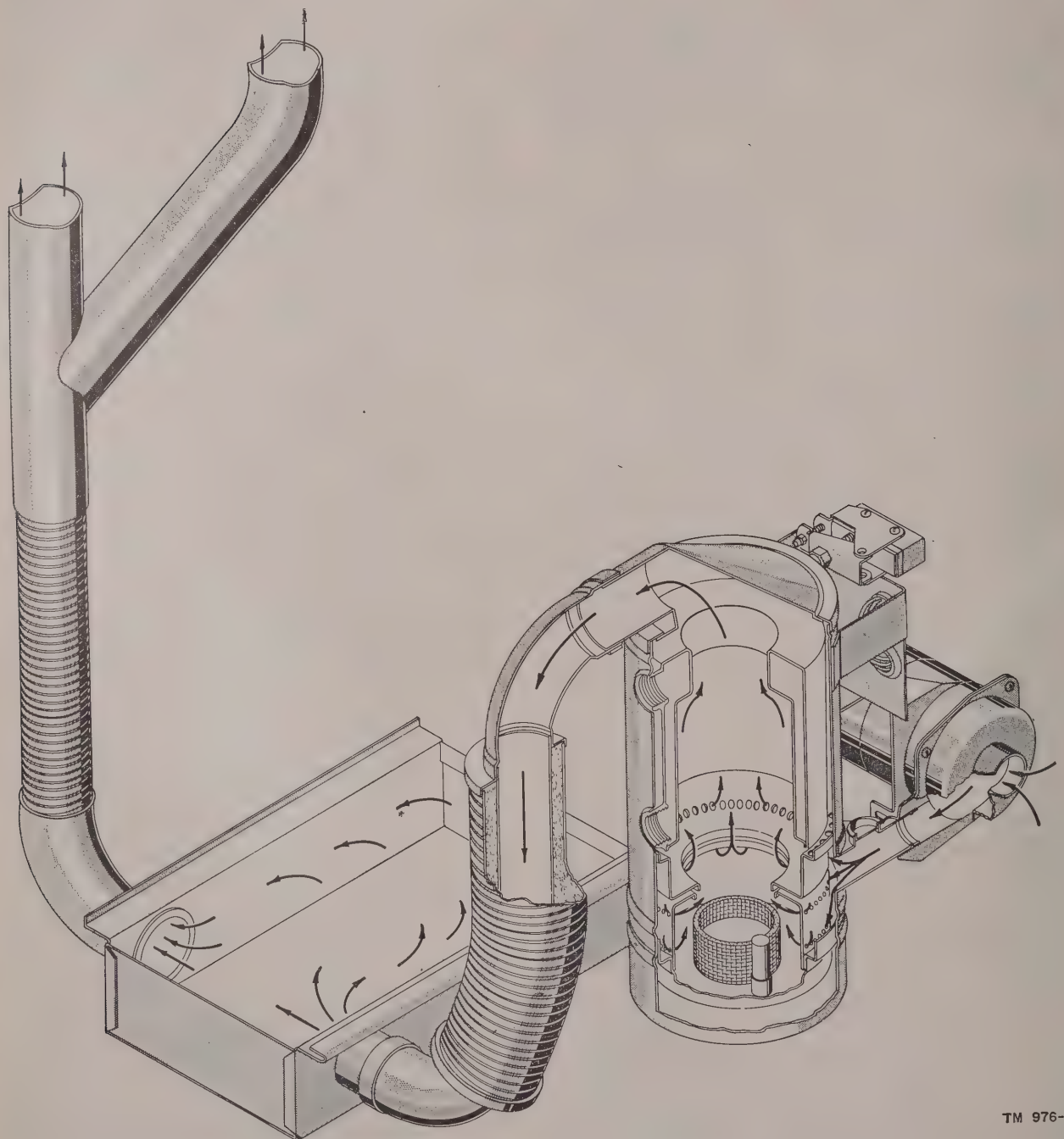
(b) Burner and throat. The air delivered by the blower is conducted to the heater burner bowl and combustion chamber through an air box and gallery. It enters the burner bowl through the primary air holes. From the primary air holes in the burner bowl, the air mixes with fuel vapor, but the mixture remains too rich to burn until sufficient secondary air is introduced through the throat opening, where combustion takes place. Air is added to the exhaust gases through the relief holes in the throat. This additional air aids combustion, but its primary purpose is to lower the exhaust gas temperatures and to provide a larger volume of warm air for external heating of the oil pan and intake manifold.

(2) *Fuel system.*

(a) Pump. The heater fuel pump supplies fuel under pressure to a 2-stage fuel control valve. This is accomplished by a solenoid which, when energized, activates a hollow plunger. The stroke of the plunger is controlled by a set of interrupter points, sealed in helium, in the electrical circuit, and a calibrated plunger spring. The pump is self-priming and requires no bleeding or adjustment. The pump provides fuel when the heater START-RUN switch is held in START position and also when it is thrown to the RUN position after the heater is ignited. The pump will not operate if the START-RUN switch is moved to the RUN position under any of the following conditions: before ignition is completed, as shown by the flashing on the heater OPERATING indicator lamp; during the purging cycle of the heater; and accidently when the heater is not being operated. The pump is not

affected by operation of the thermostat and will operate continuously whenever the heater is in use.

(b) *Fuel control valve.* The electrically operated fuel control valve consists essentially of a pressure regulator and two independent, solenoid-operated valves which control the flow of fuel to the heater through orifices. Both solenoid valves are normally closed when the coils are not energized. The shut-off valve allows fuel to flow only when the coil is energized; the high-low valve is connected into the circuit with the heater thermostat. When the coil is



TM 976-23

Figure 23. Winterization air flow diagram.

not energized, fuel is forced to flow through a restricted orifice calibrated for *low fire* operation. When the high-low valve is energized, the valve is opened and fuel passes through a bypass calibrated for *high fire* operation.

(3) *Electrical system.*

(a) Control panel. Heater components of the control panel include a START-RUN switch, a heater OPERATING indicator lamp, and the circuit breaker RESET switch. These components are discussed and the instructions for their operation are covered in paragraph 18*c*.

(b) Flame switch. The flame switch controls the electrical supply to the pump, control valve, indicator lamp, and blower motor. This switch is actuated by the presence of flame in the heater combustion chamber. The flame switch consists of a quartz rod encased in a metal tube with an integral mounting bracket which supports a microswitch and adjusting spring. The quartz rod and tube extend into the top of the heater where they are subjected to the flame. The heat causes the tube to expand and permits the quartz rod to release the microswitch button.

48. Meaning of Troubleshooting

The primary function of troubleshooting is to locate and correct the causes of faulty operation and equipment failure. All mechanical equipment is subject to occasional failure. Whenever difficulty with equipment is experienced, the operator or repairman must be able to locate and correct the cause as quickly as possible. The trouble charts (par. 49) indicate various difficulties that are likely to be experienced, symptoms which indicate that trouble exists, the possible cause, and suggested remedy. Reference to various illustrations and diagrams in this manual will aid in localizing the trouble.

49. Troubleshooting Chart

a. Engine.

Symptom	Probable cause	Remedy
1. Starting motor will not crank engine; cranks too slowly; runs too long.	Discharged battery or shorted cell	Recharge or replace battery.
	Corroded battery terminals	Clean terminals.
	Loose or dirty battery cable connections.	Tighten and clean connections.
	Engine stuck	Try with handcrank.
	Defective start relay	Replace relay.
	Defective battery-charging relay	Replace relay.
	Oil too heavy in crankcase	Refer to lubrication chart. Drain and refill with lighter oil.
	Engine ground strap connections loose.	Clean and tighten connections.
	Wire connections loose at starting motor.	Tighten connections.
	Worn starting motor brushes	Replace brushes.
	Dirty starting motor commutator	Clean with No. 0000 sandpaper.
	Worn starting motor bearings	Replace bearings.
	Burned start solenoid contacts	Replace solenoid.
	Defective shunt-field relay	Replace relay or clean contacts.
2. Engine is cranked electrically, but will not start.	Battery too weak to supply ignition while cranking.	Start with handcrank. Recharge or replace battery.
	Defective spark plugs	Clean, adjust, or replace (par. 46).
	Breaker contacts pitted or out of adjustment.	Resurface or replace contacts and adjust gap (par. 54*h*(2) and (3)).

Symptom	Probable cause	Remedy
	Empty fuel supply tank	Refill.
	Clogged or frozen fuel line	Disconnect and clean (par. 27*a*).
	Dirty fuel filter	Clean (par. 36*b*(4)).
	Clogged fuel pump strainer screen	Clean (par. 36*b*(5)).
	Defective electric choke	Use manual choke. Replace.
	Cylinders flooded	Crank with spark plugs removed. Replace carburetor needle valve.
	Poor fuel	Drain, refill with correct grade of fuel.
	Dirt in carburetor	Clean.
	Low compression	Refer to symptom 21 below.
	Incorrect ignition timing	Retime (par. 61*i*).
	No ignition current or weak ignition current.	Clean and tighten ignition circuit connections.
		Clean, adjust, or replace spark plugs (par. 46).
		Resurface, adjust, or replace breaker contacts (par. 54*h*(2) and (3)).
		Replace defective ignition capacitor or coil.
	Distributor cap or rotor cracked, burned, or carbonized.	Replace defective part.
	Leaking fuel line connections	Tighten.
	Fuel pump sediment bowl loose	Tighten thumb nut.
	Carburetor inlet valve stuck	Replace needle valve assembly.
	Engine ground strap loose or dirty	Clean or tighten.
3. Low oil pressure	Oil too light or badly diluted	Drain and refill with oil of correct grade and weight. Refer to lubrication chart.
	Oil too low	Add oil. Refer to lubrication chart.
	Oil-pressure relief valve not seating	Remove and clean.
	Worn crankshaft bearings	Replace bearings.
	Sludge on oil float screen	Remove and clean.
	Worn oil pump	Replace.
	Defective oil gage	Replace.
	Oil-pressure relief valve out of adjustment.	Add shims (par. 25*b*(6)).
	Air leak between oil float support and crankcase.	Replace gasket.
4. High oil pressure	Oil too heavy	Drain and refill with oil of correct grade and weight. Refer to lubrication chart.
	Clogged oil passage	Drain oil and clean passage.
	Oil-pressure relief valve stuck	Remove and clean.
	Oil-pressure relief valve out of adjustment.	Remove shims (par. 25*b*(6)).
	Defective oil gage	Replace.
5. Excessive oil consumption, light blue smoky exhaust.	Poor compression	Refer to symptom 21 below.
	Oil leaking from pan or connections	Replace gaskets and leaking hoses. Tighten screws and connections.
	Oil too light or diluted	Drain and refill with oil of correct grade and weight. Refer to lubrication chart.
	Bearing clearance too great	Replace bearings.
	Too much oil in crankcase	Drain excess oil.
	Excessive clearance between valve stems and guides.	Replace valves and guides.
	Faulty ignition	Refer to symptom 2 above.

Symptom	Probable cause	Remedy
	Piston rings stuck in grooves, worn, or broken.	Replace piston rings.
	Piston rings improperly fitted or weak.	Replace piston rings.
	Piston ring oil return holes clogged	Clean.
	Oil leaks at gaskets or seals	Replace.
	Too much clearance between piston and cylinder bore.	Rebore and install oversized pistons.
	Misalined connecting rods	Straighten or replace.
	Crankcase ventilator not operating	Clean crankcase ventilating control valve (par. 46).
6. Engine stops unexpectedly	Fuel tank empty	Refill.
	Coolant temperature too high	Refer to symptom 24 below.
	Coolant-temperature cutoff switch set too low.	Adjust setting (par. 19*a*(3)).
	Low oil pressure	Refer to symptom 3 above.
	Disconnected wire	Check ignition circuit.
7. Engine will not idle satisfactorily.	Crankcase ventilation control valve will not seat.	Replace valve.
	Carburetor out of adjustment	Adjust (par. 25*b*(5) or 62*f*.)
8. Engine misses	Clogged carburetor jets	Remove and clean.
	Fouled spark plugs	Clean, adjust, or replace (par. 46).
	Carburetor idle valve rough or burred.	Replace.
	Intake manifold air leak	Tighten or replace gaskets.
	Pitted or improperly adjusted ignition contacts.	Resurface, adjust, or replace contacts (par. 54*h*(2) and (3)).
	Defective ignition capacitor	Replace capacitor.
	Faulty ignition coil	Replace.
	Uneven compression	Refer to symptom 21 below.
	Tappet adjustment too close	Adjust (par. 62*c*).
	Defective ignition cable	Replace.
	Sticking valves	Grind valves.
	Weak or broken valve spring	Replace spring.
	Faulty wiring	Check ignition circuit.
	Water or dirt in fuel	Drain and refill with clean fuel.
	Engine overheated	Refer to symptom 24 below.
	Incorrect ignition timing	Retime (par. 61*i*).
9. Engine will not take full load	Carburetor-to-governor linkage too short.	Adjust (par. 25*b*).
	Low compression	Refer to symptom 21 below.
	Incorrect valve timing	Retime (par. 62*b*).
	Carbon in cylinders	Remove carbon.
10. Engine hunting under load	Carburetor-to-governor linkage too short.	Adjust (par. 25*b*).
	Governor-spring eyebolt out of adjustment.	Adjust (par. 25*b*).
11. Engine hunting under no load	Carburetor-to-governor linkage too short.	Adjust (par. 25*b*).
	Governor-bumper screw out of adjustment.	Adjust (par. 25*b*).
	Governor-spring eyebolt out of adjustment.	Adjust (par. 25*b*).
12. Engine backfires through carburetor.	Lean fuel mixture	Adjust and clean carburetor. Clean fuel filter. Tighten or replace intake manifold gasket.
	Poor grade fuel	Drain and refill with correct grade of fuel.

Symptom	Probable cause	Remedy
	Spark too late	Retime ignition (par. 61*i*).
	Distributor to spark plug wires crossed.	Install wires correctly.
	Intake valves leaking	Grind and reseat valves.
	Incorrect valve timing	Retime (par. 62*b*).
13. Light pounding knock	Loose connecting rod bearing	Tighten connecting rod cap nuts or replace bearing.
	Low oil supply	Add oil. Refer to lubrication chart.
	Low oil pressure	Refer to symptom 3 above.
	Oil badly diluted	Change oil. Refer to lubrication chart.
14. Dull metallic thud, increases with load.	Loose crankshaft bearings	Tighten or replace bearings.
15. Sharp metallic thud in cold starting.	Low oil supply	Add oil. Refer to lubrication chart.
	Low oil pressure	Refer to symptom 3 above.
	Oil badly diluted	Change oil. Refer to lubrication chart.
16. Pinging sound during rapid acceleration or overload.	Carbon in cylinders	Remove carbon.
	Spark too early	Retime ignition (par. 61*i*).
	Wrong spark plugs	Replace with new plugs.
	Spark plugs burned or carboned	Clean or install new plugs (par. 46).
	Valves hot	Adjust tappets (par. 62*c*).
	Fuel stale or low octane	Use correct grade fuel.
	Lean fuel mixture	Adjust carburetor.
17. Clicking sound	Tappet clearance too great	Adjust tappets (par. 62*c*).
	Broken valve spring	Install new spring.
18. Hollow clicking sound	Loose pistons	If noise is slight, and disappears after warm up, no immediate attention needed. If noise increases, replace piston pins.
19. Popping, spitting, or detonation.	Incorrect ignition timing	Retime (par. 61*i*).
	Improper carburetion	Adjust and clean carburetor.
	Poor valve seating	Grind valves and reseat.
	Sticking valves	Refer to symptom 23 below.
	Broken valve spring	Replace spring.
	Tappets adjusted too closely	Adjust tappets (par. 62*c*).
	Spark plug electrodes burned	Replace spark plugs.
	Water or dirt in fuel	Drain fuel.
	Clogged fuel lines	Blow out lines.
	Improper valve timing	Retime (par. 62*b*).
20. Engine lacks power	Low compression	Refer to symptom 21 below.
	Dirt in carburetor or fuel pump	Clean.
	Dirty air cleaner	Clean, refill to proper level. Refer to lubrication chart.
	Improper setting of air-inlet gage on air cleaner.	Change setting (par. 16*a*).
	Choke inoperative	Use manual choke. Replace electric choke.
	Carbon in cylinders	Remove carbon.
	Restricted exhaust line	Clean.
	Incorrect ignition or valve timing	Retime (par. 61*i* or 62*b*).
	Carburetor flooded or dirty	Clean carburetor. Check float level and float needle valve (par. 54*c* (3) (*a*)).
	Inlet air restricted	Clean air cleaner.
	Engine overheated	Refer to symptom 24 below.
	Fuel lines clogged	Drain and clean.
	Improper tappet clearance	Adjust (par. 62*c*).
	Sticking valves	Grind and reseat valves.
	Piston rings broken or worn	Replace rings.

Symptom	Probable cause	Remedy
21. Low or fluctuating engine compression.	Faulty cylinder head gasket	Replace.
	Insufficient tappet clearance	Adjust tappets (par. 62*c*).
	Improperly fitted pistons or piston rings.	Replace with correct fit.
	Valves not seating properly	Grind and reseat valves.
	Valve spring weak or broken	Replace spring.
	Burned valves	Grind or replace valves.
22. Lack of vacuum	Incorrect ignition timing	Retime (par. 61*i*).
	Weak valve springs	Replace springs.
	Worn valve guides	Replace guides.
	Leakage of carburetor gasket, manifold gasket.	Replace gaskets.
	Poor carburetor adjustment	Adjust carburetor (par. 25*b*(5) or 62*f*).
	Exhaust line clogged	Clean.
	Burned valves	Grind or replace valves.
23. Valves sticking	Warped valves	Replace.
	Improper tappet clearance	Adjust (par. 62*c*).
	Carbonized or scored valve stems	Buff or replace valve.
	Valve stem to guide clearance insufficient.	Replace valve and guide.
	Weak or broken valve spring	Replace spring.
	Valve spring cocked	Replace spring.
	Contaminated oil	Drain and refill. Refer to lubrication chart.
24. Engine overheating	Lack of proper lubrication	Refer to lubrication chart.
	Stoppage of coolant circulation	Check for sludge in radiator.
	Faulty thermostat	Replace.
	Lack of coolant	Refill. Refer to symptom 26 below.
	Slipping fan belt	Tighten (par. 46).
	Incorrect ignition timing	Retime (par. 61*i*).
	Clogged muffler	Clean.
	Scored or ineffective piston rings	Replace rings.
	Water pump inoperative	Overhaul or replace.
25. Engine overcooling	Thermostatic valve sticking open	Replace.
	Climatic conditions	Cover radiator to bring temperature to proper range.
26. Loss of coolant	Loose hose connections	Tighten.
	Damaged hose	Replace.
	Leaking water pump	Overhaul or replace.
	Leaking radiator	Remove and repair.
	Leaking cylinder head gasket	Replace.
	Crack in cylinder head or block	Replace.
27. Poor fuel economy	Ignition timing slow	Retime (par. 61*i*).
	Carburetor float too high	Adjust float by bending float lip.
	Fuel leakage	Check lines. Tighten connections.
	Leaking fuel pump diaphragm	Replace diaphragm or fuel pump.
	Low compression	Refer to symptom 21 above.
	Valves sticking	Grind and reseat.
	Fouled spark plugs	Replace.
	Weak ignition coil or capacitor	Replace.
	Improper valve tappet clearance	Adjust tappets (par. 62*c*).
	Dirty air cleaner	Clean and refill. Refer to Lubrication chart.
	Clogged muffler	Clean.
28. Bearing failure	Crankshaft bearing journal out-of-round.	Regrind or replace shaft.
	Lack of oil	Keep crankcase full.

Symptom	Probable cause	Remedy
	Oil leakage	Replace leaking oil seals and gaskets.
	Dirty oil	Refer to lubrication chart.
	Low oil pressure	Refer to symptom 3 above.
	Connecting rod bent	Straighten or replace.
29. Rear main bearing leak	Crankcase ventilation control valve clogged.	Clean.
	Packing deteriorated	Replace packing.
	Seal worn	Replace seal.

b. Generator.

Symptom	Probable cause	Remedy
1. Abnormal frequency regulation	Carburetor-to-governor linkage out of adjustment.	Adjust (par. 25*b*).
	Governor-spring eyebolt out of adjustment.	Adjust (par. 25*b*).
	Defective spark plugs or ignition points.	Replace plugs or ignition points (par. 46 or 54*h*(3)).
	Ignition timing off	Retime (par. 61*i*).
2. No or low voltage	CIRCUIT BREAKER in OFF position.	Place CIRCUIT BREAKER in ON position.
	Brushes binding in holders	Remove brushes and clean with lint-free, dry cloth.
	Brush spring tension too low	Replace brush spring assembly.
	Brushes worn	Replace.
	Commutator or slip rings rough, pitted, or eccentric.	Clean or resurface (par. 56*d*(6)).
	Slip rings coated	Clean or resurface (par. 56*d*(6)).
	Commutator bars shorted	Clean or undercut mica (par. 56*d*(6)).
	Voltmeter defective	Replace.
	Voltage regulator defective	Switch to manual control. Replace voltage regulator.
	Main or shunt field open	Repair or replace rotor or field ring.
	Engine-speed governor out of adjustment.	Adjust governor (par. 25*b*).
3. Low or no voltage on one phase with other phase abnormally high.	Short circuit across particular phase	Check stator with internal growler. Repair short circuit or replace stator.
4. No voltage reading in any one or all phases under no load	Voltmeter circuit open	Repair open circuit.
5. Voltage output unsteady	Poor commutation or poor brush contact at slip rings.	Refer to symptom 2 above.
	Loose connections in exciter	Tighten connections.
	Voltage regulator defective	Switch to manual control. Replace voltage regulator.
	Voltage regulator out of adjustment	Adjust voltage regulator (par. 25*b* (4)).
6. Excessive arcing present at generator brushes.	Brushes worn	Replace brushes.
	Brushes binding in holders	Remove brushes and clean with lint-free, dry cloth.
	Brush spring tension too low	Replace brush spring assembly.
	Rough, pitted, eccentric, or burned commutator or slip rings.	Clean and resurface (par. 56*d*(6)).
	Neutral setting of brush rigging off	Reset (par. 60*c*(1)).
	Shorted commutator bars	Undercut or rewind armature.

Symptom	Probable cause	Remedy
7. Generator overheats	Foreign matter in air passages	Remove obstructions.
	Brushes improperly seated	Reseat brushes.
	Short circuit in generator windings	Repair or replace stator, rotor, or exciter field ring.
	Excessive load	Correct load.

c. Winterization System.

Symptom	Probable cause	Remedy
1. Failure to ignite	Circuit breaker (RESET) open	Press in and check indicator lamp.
	Burned-out electrode	Replace electrode.
	Burned-out resistor	Replace resistor.
	Fuel pump inoperative	Refer to symptom 2 below.
	Fuel control valve failure	Replace control valve inlet screen; blow off orifice plate.
	Flame switch failure	Replace flame switch.
2. Fuel pump inoperative	Loose or dirty ground connections	Clean and tighten.
	Loose electrical wires and connections.	Check and tighten.
	Incorrect reassembly of parts	Disassemble and reassemble correctly.
	Interrupter system not functioning properly.	Replace pump.
3. Pump operates, but fails to deliver fuel.	Air leak in fuel line or at connections	Replace defective tubing; tighten connections.
	Restrictions in fuel line	Remove and clean.
	Distorted or damaged gasket	Replace gasket.
4. Failure to keep running	Flame switch control failure	Check and replace.
	Blower motor failure or slow down	Replace.
	Poor electrical connection	Check for continuity of circuits.
	Plugged exhaust line	Disconnect and clean.
	Coolant leak in burner	Check and replace leaking part.
	Dirty control valve filter	Replace control valve inlet screen; blow off orifice plate.
	Plugged feed line to burner	Remove and clean.
	Fuel pump inoperative	Refer to symptom 2 above.
	Burned, charred, or worn wick	Replace wick.
5. Failure to shut off	Flame switch failure	Remove and replace.

d. R-F Suppression Equipment.

Symptom	Probable cause	Remedy
Unsatisfactory suppression of radio frequencies.	Loose ground straps, external-internal toothed lock washers, or capacitor connections.	Tighten.
	Defective capacitor	Replace.

CHAPTER 4
FIELD MAINTENANCE INSTRUCTIONS

Section I. CLEANING, STRIPPING, AND INSPECTING

50. General

This chapter covers complete repair and overhaul instructions for Power Unit PU–26A/U and is written specifically for personnel in charge of field maintenance and repair. The instructions include detailed steps to be followed in the stripping, disassembly, cleaning, inspection, and reassembly of the unit. Exploded-view type illustrations are provided to facilitate overhaul and are indexed in accordance with the procedure of disassembly. A table of fits and tolerances and a paragraph covering adjustments after reassembly are included in the chapter. Requirements and methods for testing the unit after overhaul are furnished, together with instructions on refinishing. Installation details for r-f suppression equipment also are included.

51. Preliminary Inspection

Before repairing any part of the equipment, check the unit for the extent of repair necessary as noted by the operating personnel in DA Form 464. Inspect the unit according to Form 464 as instructed in the TI (technical inspection) column (par. 46). The technical inspection required is completed when this examination is finished and Form 464 is filled out properly.

52. Cleaning

Before stripping the unit, thoroughly clean all grease, oil, and dirt from the entire exterior of the unit. Use cleaning solvent for washing when necessary. Do not let the solvent come in contact with any electrical equipment. Blow dirt from inaccessible places with dry, compressed air.

53. Stripping

The following paragraphs contain instructions for stripping the unit of all subassemblies and accessories. To perform a major overhaul, all components and accessories must be removed from the unit for accessibility to the engine and generator.

Warning: If the unit has been operated for inspection purposes before stripping, disconnect the batteries before attempting to repair or overhaul any part of the equipment.

a. Upper Frame. The tubular frame is composed of two sections and is constructed to permit the removal of the top half. For complete overhaul of the unit, first remove the upper frame. Proceed as follows:

(1) Remove the rear panel and disconnect the generator leads connected to the back of the series-parallel change board (6, fig. 3), to the MANUAL VOLTAGE CONTROL (17, fig. 11), and to the VOLTAGE REGULATOR SW (switch) (19, fig. 11). Disconnect the two battery-charging transformer leads connected to the remote starting control chassis (4, fig. 5).

(2) Disconnet the air line from the air cleaner (8, fig. 3) to the igniter assembly (10, fig. 3). Remove the breather line from the air cleaner to the oil filler tube (12, fig. 3). Remove the inlet and outlet air duct hose from the air cleaner.

(3) Unplug the 10-conductor socket (10, fig. 2) mounted on the firewall.

(4) Disconnect the cable for the manual CHOKE (5) at the carburetor (9).

(5) Remove the clip that secures the cable for the manual THROTTLE (15) and the tube for the PRIMING PUMP (14). The clip is located on the firewall.

(6) Disconnect the capacitor from the oil-pressure transmitter (19).

(7) Disconnect the four ground straps from the right and left sides of the upper frame.

(8) Remove the nuts that secure the upper radiator brackets to the radiator.

(9) Remove the four bolts and nuts that secure the upper frame to the lower frame.

(10) Lift the upper frame off the lower frame. Be careful not to damage any parts on the unit.

b. Radiator. Before removing the radiator (14, fig. 3), open the radiator cap to prevent a vacuum. Drain the coolant through the radiator drain valve (3, fig. 2).

(1) Remove the fan guard (15, fig. 3).

(2) Loosen the radiator hose clamps and remove all necessary hose.

(3) Remove the nuts that secure the radiator to the lower frame. Slide the radiator forward in the slots to clear the fan. Then lift the radiator off the frame. Be careful not to hit the fan.

c. Muffler (fig. 2).

(1) Remove the choke rod from the automatic choke (22) and carburetor (9).

(2) Remove the automatic choke from the exhaust pipe adapter.

(3) Remove the two nuts that secure the exhaust pipe adapter to the exhaust manifold.

(4) Loosen the clamp that secures the muffler (2) to the lower frame.

(5) Slowly remove the muffler assembly. Be careful not to damage any parts on the engine.

d. Engine-Speed Governor (fig. 2).

(1) Disconnect the carburetor-to-governor linkage (7) from the governor-control arm.

(2) Unscrew the two governor oil lines. Use a can to catch the small amount of oil that will flow from the governor.

(3) Loosen the three mounting bolts and slide the governor (6) down. Remove the drive belt from the governor pulley.

(4) Remove the mounting bolts and take the governor from the engine.

e. Air Cleaner (fig. 3).

(1) Disconnect all air lines and hoses (*a*(2) above).

(2) Unscrew the four bolts that hold the air cleaner (8) to the mounting brackets and remove the air cleaner.

f. Carburetor and Overspeed Safety Governor (fig. 2). The carburetor (9) and overspeed safety governor (10) are mounted with the same studs and therefore both can be removed in the same operation. Proceed as follows:

(1) Loosen the clamp that holds the carburetor air horn and remove the horn from the carburetor.

(2) Disconnect the cable for the manual CHOKE (5) and disconnect the automatic choke rod from the carburetor-choke control.

(3) Disconnect the cable for the manual THROTTLE (15) and the carburetor-to-governor linkage (7) from the carburetor-throttle control.

(4) Remove the fuel line from the carburetor.

(5) Unscrew the two nuts that mount the carburetor and overspeed safety governor to the intake manifold.

(6) Lift the carburetor and governor off the manifold.

g. Fuel Pump (fig. 2).

(1) Disconnect the fuel lines from the fuel pump (4).

(2) Remove the two bolts that secure the fuel pump to the engine.

(3) Remove the pump from the engine.

h. Oil-Pressure Cutoff Switch and Oil-Pressure Transmitter (fig. 2).

(1) Disconnect the electrical leads from the cutoff switch (17) and the oil-pressure transmitter (19).

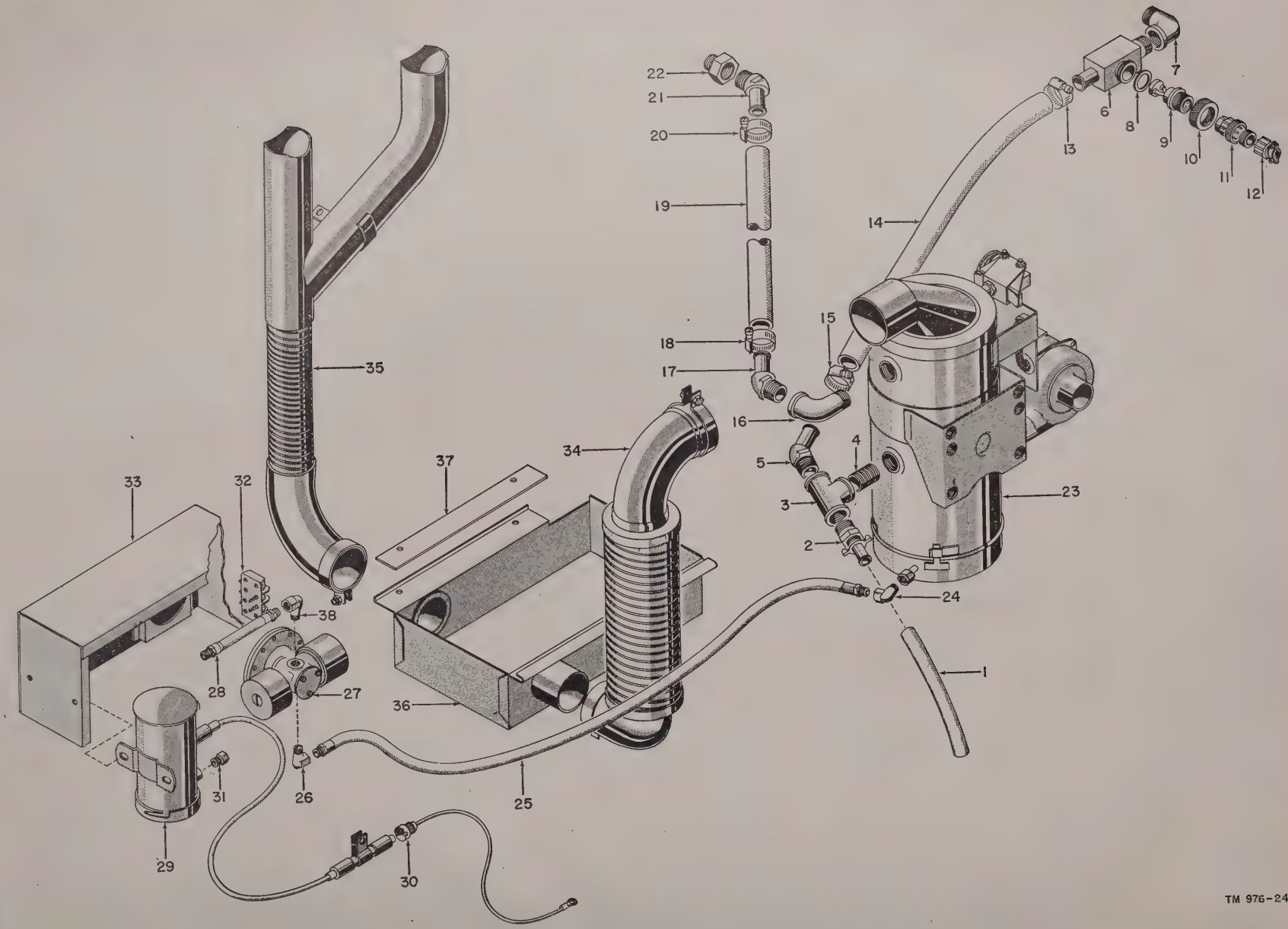


Figure 24. Winterization system, exploded view.

TM 976-24

1 Coolant drain hose (H706)
2 Coolant drain valve (H696)
3 Tee (H695)
4 Nipple (H697)
5 Elbow (H694)
6 Thermostat housing (H701)
7 Elbow (H704)
8 Gasket (H702)
9 Thermal element (S7)
10 Nut (H703)
11 Connector plug (P3)
12 Electrical clamp (E89)
13 Clamp (H700)
14 Water pump to heater hose (H699)
15 Clamp (H698)
16 Elbow (H693)
17 Elbow (H692)
18 Clamp (H691)
19 Heater to cylinder block hose (H690)
20 Clamp (H689)
21 Elbow (H688)
22 Adapter (H687)
23 Heater (O 153)
24 Elbow (H705)
25 Control valve to heater fuel hose (H686)
26 Elbow (H685)
27 Fuel control valve (L3)
28 Fuel pump to control valve hose (H684)
29 Fuel pump (L4)
30 Cable assembly (W19)
31 Connector (H280)
32 Terminal board (TB29)
33 Fuel control box (A 124)
34 Heat exchanger inlet air duct (A 127)
35 Heat exchanger to intake manifold air duct (A 125)
36 Heat exchanger pan (A 128)
37 Bracket (A 126)

Figure 24—Continued.

(2) Screw the switch and transmitter out of the tee fitting.

i. Fuel Filter (fig. 2).

(1) Open the drain cock and drain the fuel from the filter (18).

(2) Disconnect all hose fittings and remove the fuel lines from the filter.

(3) Remove the two bolts that secure the filter to the mounting bracket and remove the filter.

j. High-Coolant-Temperature Cutoff Switch (fig. 3).

(1) Disconnect the electrical lead from the cutoff switch (11).

(2) Carefully screw the cutoff switch out of the coolant outlet elbow. Do not damage the thermal element.

k. Oil Filter (fig. 3).

(1) Disconnect the hose fittings and remove the oil lines from the oil filter (13).

(2) Remove the two bolts that secure the oil filter to the bracket on the engine. Remove the filter.

l. Igniter Assembly (fig. 3).

(1) Refer to *e* above and remove the air cleaner as instructed.

(2) Disconnect the shielded ignition cables from the top of the igniter assembly (10).

(3) Disconnect the ignition lead from the igniter.

(4) Remove the bolt that secures the igniter to the engine block.

(5) Slowly pull the assembly from the engine.

m. Starting Motor (fig. 3).

(1) Remove the heater shield (20).

(2) Disconnect the electrical leads from the starting motor (9) and from the solenoid switch.

(3) Disconnect the starting motor ground strap from the engine block.

(4) Unscrew the two mounting bolts that secure the starting motor to the flywheel housing.

(5) Remove the starting motor. Be careful not to damage the drive gear or flywheel ring gear.

n. Winterization System (fig. 24). To remove individual components of the winterization system, follow the applicable instructions below:

(1) *Heater.*

(*a*) Drain the coolant by using the drain valve (2) located on the side of the heater (23). (This also will drain the coolant from the engine block.)

(*b*) Remove the heater shield.

(*c*) Unplug the electrical lead from the side of the heater.

(*d*) Disconnect the fuel hose (25) at the heater.

(*e*) Loosen the clamp that secures the heat exchange inlet air duct (34) to the combustion outlet on the heater.

(*f*) Remove the coolant hoses (14 and 19) from the fittings on the heater.

(*g*) Remove the four bolts that secure the heater to the mounting bracket. Carefully remove the heater.

(2) *Heat exchanger pan.* Remove the air ducts (34 and 35) from the heat exchanger pan (36). Then remove the bolts that secure the exchanger to the engine oil pan. Carefully slide the exchanger from the oil pan.

(3) *Fuel pump and fuel control valve.*

(*a*) Carefully disconnect the fuel lines and electrical leads from the heater fuel pump (29) and the fuel control valve (27).

(*b*) Remove the bolts and screws that secure the pump and valve to the heater control box (33) and take the pump and valve from the unit.

54. Detailed Inspection

This paragraph contains instructions for disassembly, cleaning, inspection, and reassembly of all subassemblies and accessories removed from the unit in paragraph 53.

a. Engine-Speed Governor (fig. 25). After the engine-speed governor has been removed (par. 53*d*), proceed as follows:

(1) *Disassembly.*

(*a*) Remove the pulley (1) by driving the groove pin (2) from the drive shaft (21). Tap the pulley with a soft hammer, if necessary.

(*b*) Remove the adjustment slide (3) and the control-arm spring (4).

(*c*) Unscrew the upper adjustment nut (5) and remove the control-arm eyebolt (7).

(*d*) Punch the groove pin (8) out of the control shaft (32) and slide the control arm (9) off the shaft.

(*e*) Remove the end bell (10) from the governor body (33). The drive shaft and flyweight assembly will slip out with the end bell.

(*f*) Slide the thrust sleeve (11) and the thrust bearing (12) off the shaft. Press the bearing off the sleeve.

(*g*) Remove the flyweights (13) from the drive shaft by removing the spring clips (14) and the flyweight pin (15).

(*h*) Remove the snap ring (17) with pliers or a screw driver and drive the shaft and bearing (20) from the end bell. Pull the oil retainer (18) from the end bell.

(*i*) Remove the snap ring (19) and pull the bearing off the drive shaft.

(*j*) Using a bearing puller, remove the bearing (22) from the governor body.

(*k*) Pry the plug (23) from the body with a screw driver or punch. Then remove the snap ring (24).

(*l*) Remove the yoke (25). Then remove the bumper screw (26) and the bumper spring (27) by loosening the locknut.

(*m*) Drive the control shaft (32) out of the body and remove the bearing (28) from the body with a bearing puller.

(*n*) Slide the oil retainer (29) off the shaft.

(*o*) Remove the snap ring (30) and pull the bearing (31) from the shaft.

(2) *Cleaning and inspection.* Clean all parts of the governor with fuel oil (D–40 or D–35) or cleaning solvent. Inspect all the governor parts for the conditions indicated below.

(*a*) *Pulley* (1). Replace if misalined or dented.

(*b*) *Adjustment slide* (3). Replace if bent or dented.

(*c*) *Control-arm spring* (4). Check the spring for free length and tension. Free length should be 2⅝ inches. The pressure should be between 38 and 46 pounds at ¼-inch deflection and 70 pounds at ½-inch deflection. Replace if out of tolerance.

(*d*) *Control arm* (9). Replace if bent or damaged.

(*e*) *End bell and governor body* (10 and 33). Replace if pitted or cracked.

(*f*) *Thrust sleeve* (11). Replace if worn.

(*g*) *Thrust bearing* (12). Replace if scored or pitted.

(*h*) *Flyweights* (13). Replace if scuffed or if the needle bearings are worn or pitted.

(*i*) *Flyweight pins* (15). Replace if worn.

(*j*) *Bearings* (20, 22, 28 and 31). Replace if scored or pitted.

(*k*) *Oil retainers* (18 and 29). Replace if worn if there is evidence of leaking.

(*l*) *Bumper spring* (27). Replace if worn, flexed, or cracked.

(*m*) *Drive shaft and control shaft* (21 and 32). Replace if misalined or worn.

(3) *Reassembly.* After cleaning and inspecting to determine the necessary replacement parts, reassemble the governor as follows:

(*a*) Press the bearings (22 and 28) into the governor body (33).

(*b*) Slide the bearing (31) on the control shaft (32). Install the snap rings (30) in the shaft groove.

(*c*) Install the control shaft in the governor body and insert the snap ring (24) in the shaft groove. The shaft must turn freely. Tap the oil retainer (29) into the body and insert a new plug (23). Screw the yoke (25) into the shaft.

(*d*) Press the bearing (20) onto the drive shaft (21). Install the snap ring (19) in the shaft groove. Install the flyweights (13) and the flyweight spacers (16) on the shaft with pins (15) and spring clips (14).

(*e*) Press the thrust bearing (12) on the thrust sleeve (11). Make certain the bearing fits snugly against the shoulder on the sleeve. Then slide the bearing and sleeve onto the drive shaft.

(*f*) Lightly tap the oil retainer (18) into the end bell (10). Install the drive shaft in the end bell and insert the snap ring (17) in the end bell groove. Install a new gasket (34) and secure the end bell to the governor body. Tap the pulley (1) onto the drive shaft and insert the groove pin (2).

(*g*) Install the control arm (9) on the control shaft (32) with the groove pin (8). Slip the control-arm eyebolt (7) into the control arm and secure it with the upper adjusting nut (5).

(*h*) Secure the adjustment slide (3) to the governor body and hook the spring (4) to the adjustment slide and control-arm eyebolt.

(*i*) Install the bumper spring (27) and the bumper screw (26) in the governor body and tighten the locknut.

b. Air Cleaner (fig. 14). Refer to paragraph 36*b*(2) and disassemble and clean the air cleaner as instructed.

c. Carburetor (fig. 26). After the carburetor has been removed from the unit (par. 53*f*), proceed as follows:

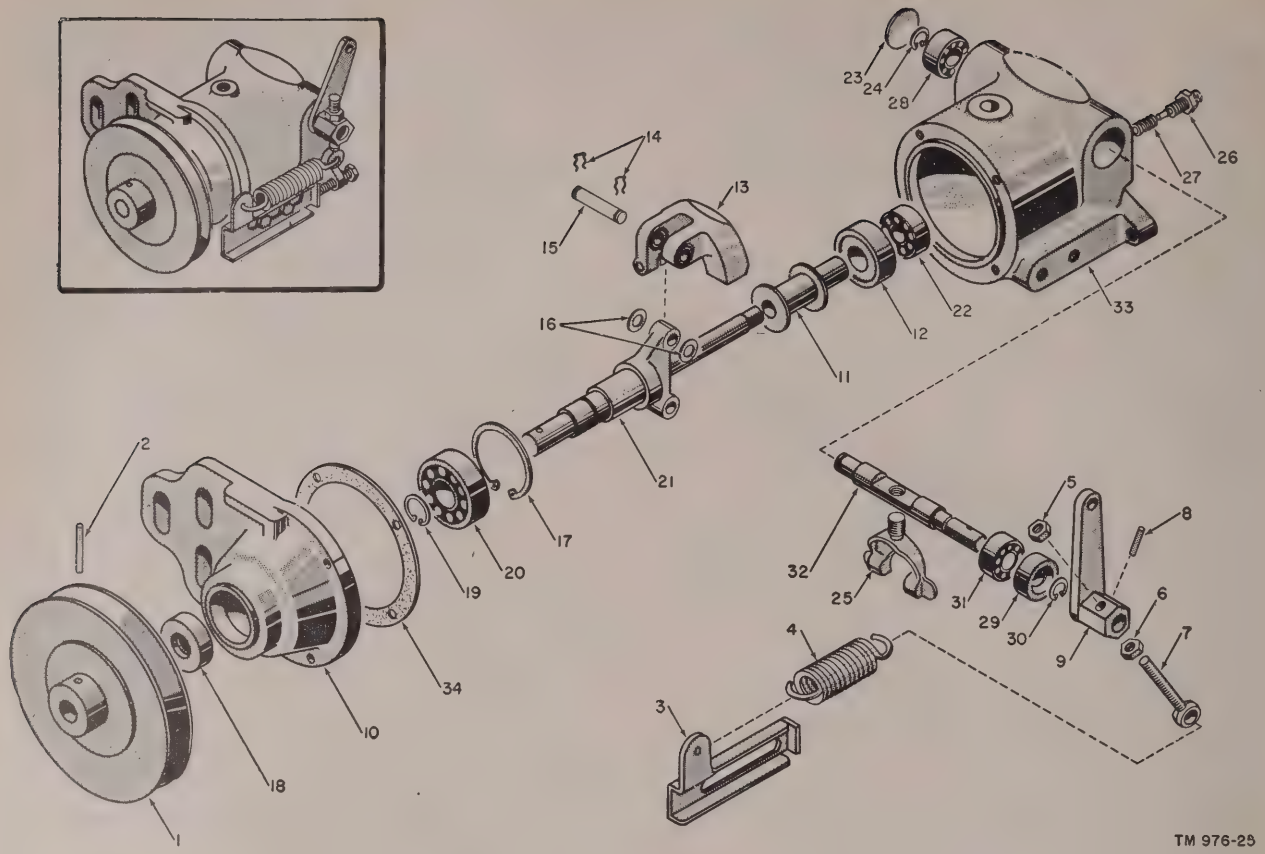
(1) *Disassembly.*

(*a*) Remove the air horn (1) with all parts attached.

(*b*) Remove the throttle-shaft arm (3) with all parts attached.

(*c*) Remove the bowl cover (6) with all parts attached.

(*d*) Remove the pump-jet-passage plug (7), gasket (8), and pump jet (9) from the body (28).



1 Pulley (O 100)
2 Groove pin (H367)
3 Adjustment slide (A 37)
4 Control-arm spring (O 107)
5 Upper adjusting nut (H391)
6 Lower adjusting nut (H393)
7 Control-arm eyebolt (H394)
8 Groove pin (H392)
9 Control arm (H390)
10 End bell (A 35)
11 Thrust sleeve (O 103)
12 Thrust bearing (O 104)
13 Flyweights (O 96 and O 97)
14 Spring clips (H374 through H377)
15 Flyweight pins (H372 and H373)
16 Flyweight spacers (H368 through H371)
17 Snap ring (H384)
18 Oil retainer (381)
19 Snap ring (H383)
20 Bearing (O 101)
21 Drive shaft (O 102)
22 Bearing (O 105)
23 Plug (H378)
24 Snap ring (H379)
25 Yoke (H387)
26 Bumper screw (H380)
27 Bumper spring (O 99)
28 Bearing (O 98)
29 Oil retainer (H388)
30 Snap ring (H389)
31 Bearing (O 108)
32 Control shaft (O 106)
33 Governor body (A 36)
34 Gasket (H382)

Figure 25. Engine-speed governor, exploded view.

(*e*) Remove the low-speed-jet plug (10), gasket (11), and low-speed jet (12).

(*f*) Remove the altitude-adjusting screw (13) and the spring (14).

(*g*) Remove the idle-well plug (15), gasket (16), and idle-well jet (17).

(*h*) Remove the nozzle-passage plug (18), gasket (19), nozzle-retainer plug (20), nozzle (21), and nozzle gasket (22).

(*i*) Remove the idle-adjusting screw (23) and the spring (24).

(*j*) Remove the metering-rod jet (25) and the gasket (26).

(*k*) Remove the flange (27) from the body (28). Remove the insulator (29) and the gaskets (30).

(*l*) Remove the strainer-passage plug (31), gasket (32), strainer (33),

intake-ball-check plug (34), and discharge-disk-check plug (35).

(*m*) Remove the idle-port-rivet plug (36).

(*n*) Remove the throttle valve (37) and the throttle shaft and lever assembly (38).

(*o*) Remove the choke valve (40), choke shaft (41), choke-lever, extension (42), and choke-operating arm (43).

(*p*) Remove the metering rod (45), metering-rod disk (46), pump arm and collar assembly (49), connector link (48), spring clip (47), pump operating lever assembly (50), float (54), needle valve and seat assembly (55) and pump plunger (52) from the bowl cover (6).

(2) *Cleaning and inspection.* Clean all castings and parts of the carburetor with cleaning solvent. Blow out all passages with compressed air. Check the bowl cover (6) for warpage. Examine each part, and replace those parts that are worn or damaged. Clean carbon from the bore of the flange (27) by scraping, or with sandpaper; do not use emery cloth.

(3) *Reassembly.* To reassemble the carburetor follow the instructions below. Install all parts securely and use all new gaskets.

(*a*) Install the needle valve and seat assembly (55) in the float bowl cover (6). Then install the float (54) and the float hinge pin (53). Check the float level by measuring the distance between the end of the float opposite the float pin and the surface of the float bowl cover. (The cover gasket must not be in place when taking this measurement.) The correct clearance between the float and the surface of the float bowl cover must be three-eighths inch. If this measurement is not correct, bend the lip of the float arm as required to correct it.

(*b*) Install the pump jet (9), gasket (8), and pumping-jet-passage plug (7) in the carburetor body (28).

(*c*) Install the discharge-disk-check plug (35) and the intake-ball-check plug (34). Insert the strainer (33) in the recessed portion of the strainer-passage plug (31). Then install the strainer-passage plug as assembled.

(*d*) Install the throttle shaft and lever assembly (38) and the throttle valve (37). Install the valve with the C toward the idle port opening and facing the manifold side of the flange (27). Tap the throttle valve lightly to centralize it in the bore of the carburetor. Hold the valve in place and securely tighten the screws. Always use new screws.

(*e*) Install the new idle-port-rivet plug (36). Then install the idle adjusting screw (23) and the spring (24).

(*f*) Assemble the flange (27) to the body (28). Use new gaskets (30). Line up the holes in the body casting with the holes in the insulator (29), gaskets (30), and flange before tightening the screws. Use lock washers.

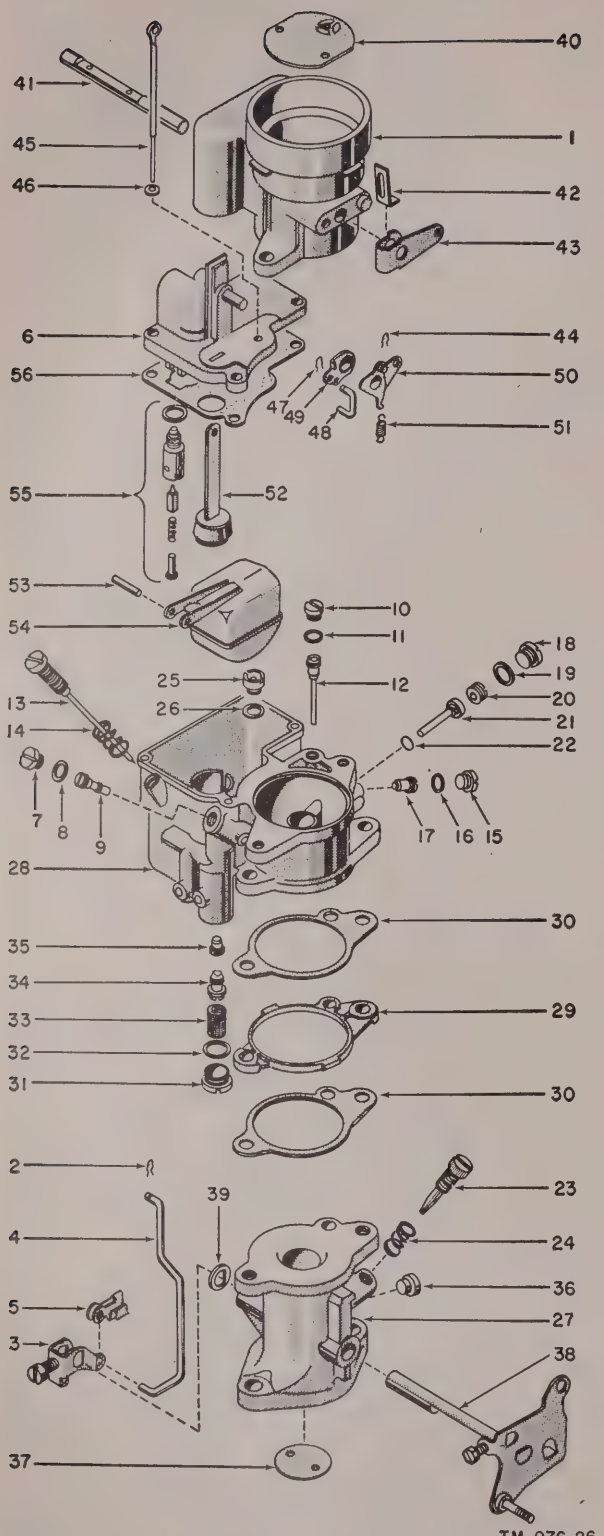
(*g*) Install the idle-well jet (17), gasket (16), and idle-well-jet-passage plug (15) in the body.

(*h*) Install the low-speed jet (12). Work it well into the seat to insure a good seal. Then install the gasket (11) and the low-speed-jet-passage plug (10).

(*i*) Install the gasket (26) and the metering-rod jet (25).

(*j*) Slip the pump plunger (52) into the body (28). Place a gasket (56) on the bowl cover (6) and install the float and cover assembly. Tighten the screws evenly and securely.

(*k*) Install the pump arm and collar assembly (49) and the pump operating lever assembly (50) to the bowl cover. Attach the connector link (48) with the spring clip (47).



(*l*) Install the washer (39) and throttle-shaft arm (3) on the throttle shaft. Then attach the throttle-connector rod (4). Use a new spring retainer (5) at the lower end and the spring clip (2) at the top.

(*m*) Install the metering rod (45) and the disk (46). Secure with the spring clip (44).

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1 Air horn (A 6)
2 Spring clip (H89)
3 Throttle-shaft arm (H94)
4 Throttle-connector rod (H91)
5 Spring retainer (H93)
6 Bowl cover (A 7)
7 Pump-jet-passage plug (H79)
8 Gasket (H79)
9 Pump jet (H80)
10 Low-speed-jet plug (H70)
11 Gasket (H70)
12 Low-speed jet (H74)
13 Altitude-adjusting screw (H72)
14 Spring (O 46)
15 Idle-well plug (H82)
16 Gasket (H82)
17 Idle-well jet (H81)
18 Nozzle-passage plug (H75)
19 Gasket (H75)
20 Nozzle-retainer plug (H76)
21 Nozzle (H77)
22 Nozzle gasket (H78)
23 Idle-adjusting screw (H90)
24 Spring (O 48)
25 Metering-rod jet (H73)
26 Gasket (H73)
27 Carburetor flange (A 9)
28 Carburetor body (A 8)
29 Insulator (H86)
30 Gaskets (H84 and H88)
31 Strainer-passage plug (H87)
32 Gasket (H87)
33 Strainer (H85)
34 Intake-ball-check plug (O 47)
35 Discharge-disk-check plug (H83)
36 Idle-port-rivet plug
37 Throttle valve (O 49)
38 Throttle shaft and lever assembly (O 50)
39 Washer (H92)
40 Choke valve (O 40)
41 Choke shaft (O 39)
42 Choke-lever extension (H62)
43 Choke-operating arm (H63)
44 Spring clip (H67)
45 Metering rod (H60)
46 Metering-rod disk (H61)
47 Spring clip (H65)
48 Connector link (H66)
49 Pump arm and collar assembly (O 41)
50 Pump operating lever assembly (O 42)
51 Spring (O 43)
52 Pump plunger (O 45)
53 Float pin (H69)
54 Float (O 44)
55 Needle valve and seat assembly (H68)
56 Bowl-cover gasket (H64)

Figure 26. Carburetor, exploded view.

(*n*) Install the nozzle gasket (22) and the nozzle (21) with the flat side facing up. Then install the nozzle-retainer plug (20), gasket (19), and nozzle-passage plug (18).

(*o*) Install the altitude-adjusting screws (13) and the spring (14).

(*p*) Attach the air horn (1) on the carburetor body. Tighten the screws evenly and securely.

(*q*) Install the choke shaft (41), choke-lever extension (42), choke-operating arm (43), and the choke valve (40). Centralize the valve in the air horn, then securely tighten the screws. Always use new screws.

d. Engine Overspeed Safety Governor (fig. 27). After the overspeed safety governor has been removed from the unit (par. 53*f*), proceed as follows:

(1) *Disassembly.*

(*a*) Remove the seal (1), seal pin (2), cover screws (3), cover (5), and cover gasket (6). Back out the adjusting screw (7). Remove the fulcrum clip (9) and lift the cam assembly (10) off the fulcrum. Remove the spring block (11) from the spring (12) by holding the spring and turning the block clockwise. Lift the spring out of the spring link end of the cam.

(*b*) Remove the two housing-to-flange screws (13) and the throttle plate screws (14). Then slip out the throttle plate (16) and the stabilizer piston (17). Save the piston pin (18) and piston-link spacers (19). Press the bolt-hole tube (20) from the flange (21). Remove the shaft and lever assembly (22). The bearings (23) and shim washer (26) will fall out of the housing (24).

(*c*) Fasten the flange in a vise with the cylinder cap (25) down and insert a bent rod through the cylinder. Tap until the cap comes off.

(2) *Cleaning and inspection.* Wire all parts together and clean and rinse in cleaning solvent. Inspect all parts for wear. Pay special attention to the cam, link, shaft, and piston.

(3) *Reassembly.* After cleaning and inspection, reassemble the overspeed safety governor. Use new parts wherever necessary.

(*a*) Insert the shaft and lever assembly (22) through the housing (24). Place the bearings (23) around the shaft in the sleeve, and position the shim washer (26) over the shaft and bearings.

(*b*) Put the shaft through the hole in the flange (21) and secure the flange to the housing with the screws (13). Press the bolt-hole tube (20) into the flange.

(*c*) Assemble the piston (17) to the throttle plate (16) and secure it to the shaft. Press on the cylinder cap (25).

(*d*) Attach the spring (12) to the cam assembly (10). Then turn the spring block (11) into the spring until three to four active coils are attained. Put the cam on the fulcrum pin and fasten with the fulcrum clip (9).

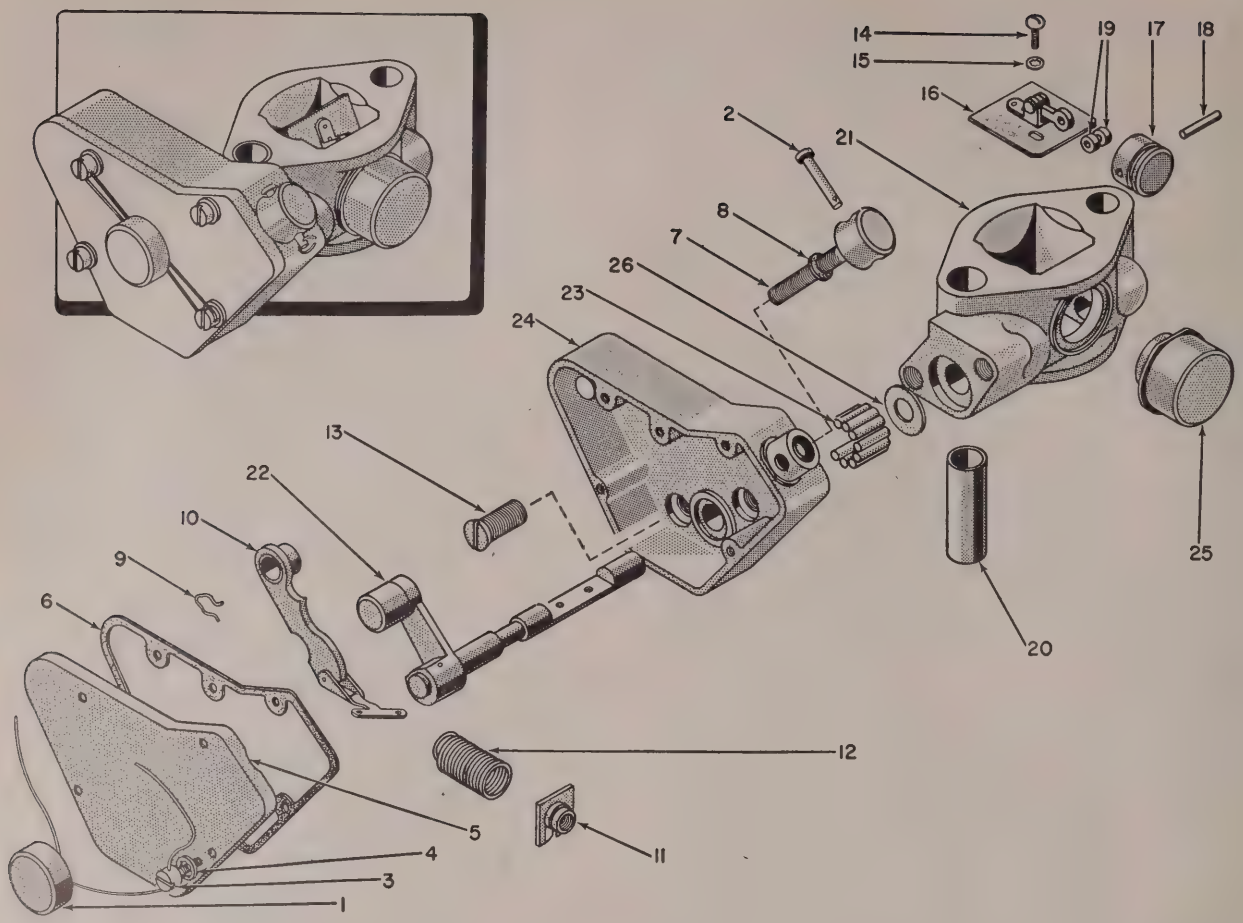
(*e*) Insert the adjusting screw (7) into the housing and the spring block. Turn the screw until the distance from the inside of the housing (at adjusting screw end) to the spring block measures five-eighths inch. Put the seal pin (2) through the adjusting screw cap. Do not seal the pin until the governor has been adjusted (par. 62*e*).

(*f*) Use a new gasket (6) and secure the cover (5) to the housing. Lock the attaching screws with a new seal (1).

e. Fuel Pump (fig. 28). After the fuel pump has been removed (par. 53*g*), proceed as follows:

(1) *Disassembly.*

(*a*) Loosen the bail thumb nut, swing the wire bail and screw assembly



TM 976-27

1	Seal	10	Cam assembly	19	Piston-link spacer
2	Seal pin	11	Spring block	20	Bolt-hole tube
3	Cover screw	12	Spring	21	Flange
4	Lock washer	13	Housing-to-flange screw	22	Shaft and lever assembly
5	Cover	14	Throttle-plate screw	23	Bearings
6	Cover gasket	15	Lock washer	24	Housing
7	Adjusting screw	16	Throttle-plate assembly	25	Cylinder cap
8	Adjusting-screw washer	17	Stabilizer piston	26	Shim washer
9	Fulcrum clip	18	Piston pin		

Figure 27. Overspeed safety governor, exploded view.

(1) out of position and remove the bowl (2) and the bowl gasket (3).

(*b*) Remove the strainer screen (4) from the top cover (5).

(*c*) Mark the edges of the top cover and body (6) with a file to assure that the parts will be reassembled in the same position. Then remove the top cover screws and lock washers. Tap the top cover loose from the body with a screwdriver handle. Lay the top cover on a bench with the diaphragm flange up.

(*d*) Remove the two screws (7) that hold the valve and cage retainer (8). Then lift out the valve and cage retainer, the two valve and cage assemblies (9 and 10), and the gasket (11).

(*e*) Drive the rocker-arm pin (12) out of the body with a punch and hammer. Remove the rocker arm (13), spring (14), and link (15). Lift out the diaphragm (16), spring retainer (17), and spring (18).

(2) *Cleaning and inspecting.* Clean and

rinse all parts in cleaning solvent. Blow out all passages with compressed air. Inspect all parts of the fuel pump as follows:

(*a*) *Top cover and pump body* (5 and 6). Make a visual check for cracks and breakage. Inspect for diaphragm flange warpage by testing on a smooth, flat surface. Examine all threaded holes for stripping or crossed threads. Broken, damaged, or severely warped castings must be replaced.

(*b*) *Valve and cage assemblies* (9 and 10). Replace. Extent of wear cannot be determined visually.

(*c*) *Strainer screen* (4). Replace. Inspect new screen for damage or obstruction. Screen must fit snugly around inner and outer edges.

(*d*) *Rocker arm* (13). Inspect for wear or scores on camshaft pad and on point of contact with link and pull rod.

(*e*) *Rocker-arm pin* (12). Replace pin.

(*f*) *Link* (15). Replace link. Amount of wear cannot be determined visually.

(*g*) *Rocker-arm spring and diaphragm spring* (14 and 18). Replace. Spring may be weak from distortion or corrosion.

(*h*) *Diaphragm* (16). Always replace.

(*i*) *Gaskets* (3 and 11). Replace.

(3) *Reassembly.* After cleaning and inspection, reassemble the fuel pump as follows:

(*a*) Soak a new diaphragm (16) in clean fuel oil (D–40 or D–35) while performing the following steps:

(*b*) Place the rocker arm (13) and the link (15) in the body (6) with the link hook down. Then aline the rocker-arm pin hole with the hole in the body, and drive in the rocker-arm pin (12). Install the rocker-arm spring (14).

(*c*) Place the diaphragm spring (18) over the pull-rod well in the body. Place the spring retainer (17) on the spring and hook the diaphragm assembly to the link by pressing the diaphragm against the spring.

(*d*) Place the valve gasket (11) in position in the top cover (5) and insert the two valve and cage assemblies (9 and 10). The outlet valve (9) must have the three-legged spider facing into the top cover, and the inlet valve (10) must have the three-legged spider facing out of the top cover. Secure the valve and cage assemblies with the valve retainer (8) and the two retainer screws (7).

(*e*) Turn the top cover so that the diaphragm flange rests on the bench and install the strainer screen (4), bowl gasket (3), and bowl (2) in that order. Swing the wire bail and screw assembly (1) into position and tighten the thumb nut.

(*f*) Install the top cover on the body. Be sure to line up the file marks. Install the screws and lock washers and tighten until the screws just engage the lock washers. Push the rocker arm in a full stroke. Allow it to snap out under the power of the diaphragm spring. Sufficient diaphragm cloth must be pulled inside the pump before the screws can be tightened; this will permit proper diaphragm flexibility.

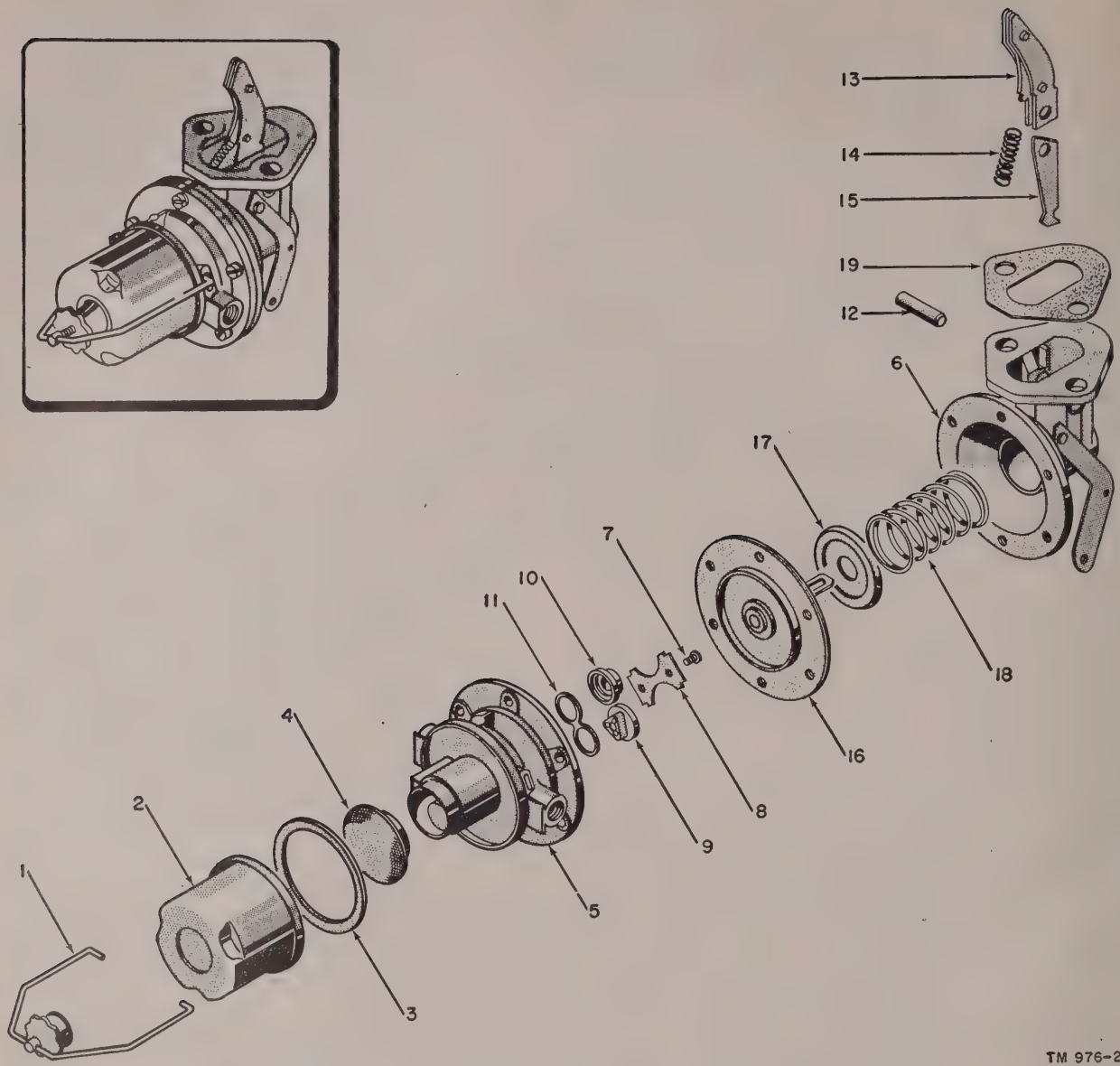
(*g*) Tighten the cover screws alternately and securely.

(*h*) Test the fuel pump with a vacuum gage. The outlet pressure should read 2.5 psi minimum and 3.5 psi maximum. The vacuum lift at the inlet should read 8 inches or over.

f. Fuel Filter (fig. 16). Disassemble and clean the fuel filter as instructed in paragraph 36*b*(4).

g. Oil Filter (fig. 15). Disassemble and clean the oil filter as instructed in paragraph 36*b*(3).

h. Igniter Assembly (fig. 29). After the igniter assembly has been removed (par. 53*l*), proceed as follows:



1 Wire bail and screw assembly (H291)
2 Pump bowl (A 29)
3 Bowl gasket (H292)
4 Strainer screen (H293)
5 Top cover (A 30)
6 Pump body (A 31)
7 Retainer screw
8 Valve and cage retainer (H295)
9 Outlet valve and cage assembly (O 87)
10 Inlet valve and cage assembly (O 88)
11 Valve gasket (H294)
12 Rocker-arm pin (H301)
13 Rocker arm (H304)
14 Rocker-arm spring (O 91)
15 Link (H303)
16 Diaphragm (O 89)
17 Spring retainer (H296)
18 Diaphragm spring (O 90)
19 Pump gasket (H302)

Figure 28. Fuel pump, exploded view.

(1) *Disassembly.*

(*a*) Take out the six screws (2) securing the cover (1) and lift the cover off the base (46). Remove the seal ring (47) from the top of the base.

(*b*) Sketch the relationship between the rotor (3) and the offset drive tongue on the bottom of the drive shaft (45) to facilitate reassembly. Pull the rotor from the top of the cam and stop plate (11).

(*c*) Disconnect the primary leads from

the ignition coil (5). Remove the two mounting screws (4) and lift coil out of the base.

(*d*) Take out the two breaker-plate mounting screws (6) and clamps (7). Remove the breaker plate (8) from the base.

(*e*) Remove the felt wick (9) from the cam sleeve. Take out the snap ring (10) in the sleeve. Lift off the cam and stop plate.

(*f*) Slip the governor springs (14) off the lugs on the weight plate. Slide the governor weights (15) off the pivots and remove the springs from the weight pins.

(*g*) Take out the attaching screw (16), lock washer (17), and plain washer (18) and remove the advance arm (19) and thrust washer (20).

(*h*) Take out the four screws (26) and remove the primary connector (22), gasket (23), capacitor (24), and gasket (25).

(2) *Cleaning and inspection.* Clean all igniter assembly parts and inspect for abnormal conditions as instructed below.

(*a*) *Distributor cap* (27).

1. Take out the three screws (28) and remove the cap from the cover (1). Remove the rubber seals (30) from the cap towers.

2. Discard the cap if it is cracked, has corroded terminals, or if carbon runners have formed on either the inside or outside surfaces. Inspect the contacts on the inside of the cap. After normal use, the contacts become slightly burned on the inside tip. If burning is excessive or uneven, replace the cap. Burning on the horizontal face of the contacts indicates that the rotor is too short and must be replaced. Clean the contacts with carbon tetrachloride but do not file. Do not clean the carbon contact with solvent. Wipe thoroughly and inspect for cracks and oil-soaked condition. Replace the cap if the carbon contact is not in good condition.

3. Replace the rubber sealing washers if they are rough or do not fit properly.

4. Thoroughly clean the cap cover with cleaning solvent and inspect for cracks or other damage. Place the cover on the base and inspect to make sure it touches the base on all sides. Replace the cover, if distorted.

5. Place the rubber washers on the cap towers and install the cap in the cover. Install the three screws and tighten evenly.

(*b*) *Rotor* (3). Discard the rotor if it is cracked or has a loose or burned contact strip. Inspect the end of the contact. If burning is excessive, replace the rotor. If burning is only slight, clean with carbon tetrachloride. Do not file. Inspect the contact spring and replace the rotor if the contact does not spring back instantly when the contact button is pressed against the rotor. Clean the button on the carbon contact in the center of the cap.

(*c*) *Ignition coil* (5). Test with a coil tester.

(*d*) *Breaker plate* (8).

1. Remove the breaker-spring clamp screw (31), washers (32 and 33), and clamp (39). Take off the coil primary lead (36). Remove the stationary contact lockscrew (38) and lift the breaker contact (37) from the breaker plate (8). Take out the capacitor mounting screw (34). Then lift the capacitor (35) off the breaker plate.

2. Clean all parts with cloth dampened with cleaning solvent.

3. Rub contacts with linen tape dampened with carbon tetrachloride. Dry with clean tape to remove any residue.

4. Test the capacitor for capacitance and grounds on a conventional

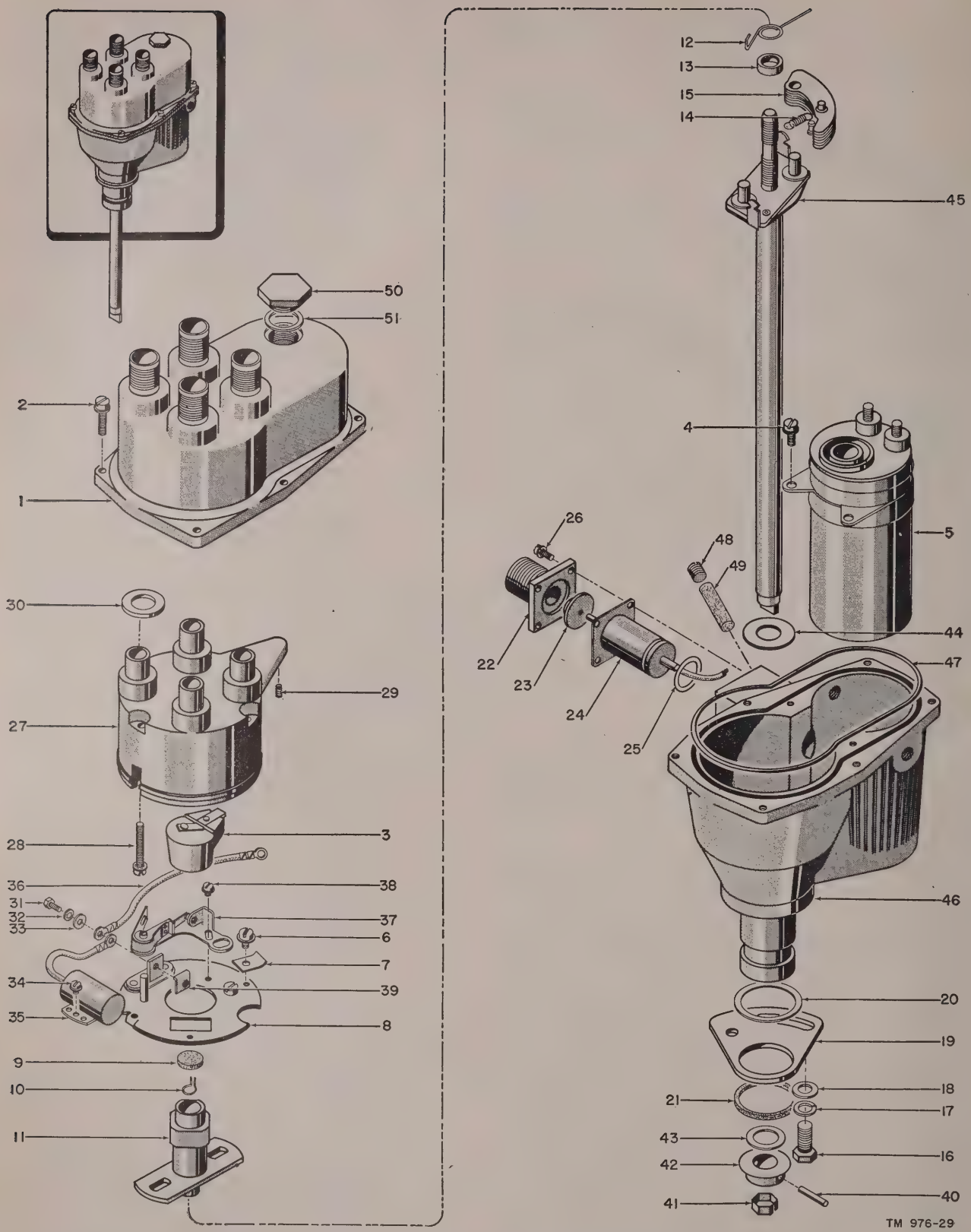


Figure 29. Igniter assembly, exploded view.

1 Cover (E20)
2 Cover screws (H406 through H411)
3 Rotor (E22)
4 Coil-bracket screws (H435 and H436)
5 Ignition coil (T1)
6 Breaker-plate screws (H423 and H424)
7 Breaker-plate clamps (H425 and H426)
8 Breaker plate (H429)
9 Cam-sleeve felt wick (H430)
10 Snap ring (H431)
11 Cam and stop plate (O 113)
12 Antirattle spring (O 114)
13 Cam collar (H432)
14 Governor-weight springs (O 115 and O 116)
15 Governor-weights (H433 and H434)
16 Advance-arm screw
17 Lock washer
18 Plain washer
19 Advance arm (H454)
20 Advance-arm thrust washer (H453)
21 Gasket (H455)
22 Primary connector (J8)
23 Gasket (H445)
24 Capacitor (C2)
25 Gasket (H446)
26 Screws (H439 through H442)
27 Distributor cap (E3)
28 Screws (H416 through H418)
29 Coil-contact spring (E21)
30 Seals (H412 through H415)
31 Breaker-spring clamp screw (H420)
32 Lock washer (H421)
33 Plain washer (H422)
34 Capacitor-mounting screw (H427)
35 Capacitor (C1)
36 Primary lead (W1)
37 Breaker contact (E2)
38 Breaker-contact lock screw (H419)
39 Breaker-arm spring clamp (H428)
40 Collar rivet (H459)
41 Friction spring (H458)
42 Shaft collar (H457)
43 Lower thrust washer (H456)
44 Upper thrust washer (H447)
45 Drive shaft (O 117)
46 Base (A 40)
47 Seal ring (H448)
48 Plug (H443)
49 Lubricating wick (H444)
50 Cap-cover plug (H404)
51 Cover-plug gasket (H405)

Figure 29—Continued.

tester. Replace the capacitor if grounded, leaky, or if capacitance is not within the range of .18 to .21 μf. Replace the capacitor if the lead or terminal is chafed, partially broken, or damaged.

5. Inspect the plate for stripped threads and a damaged or worn pivot pin, and replace the plate if these conditions are found. Check the primary terminal for grounds with test probes. Replace the plate if the terminal is grounded.

6. Inspect the contacts. If they are a grayish color and are not pitted or burned, they need not be replaced. Replace the contacts if rough, burned, or pitted.

7. Install the contacts on the plate. They must turn easily without binding. Remove the contact assembly and inspect the pivot. Replace the plate if wear is evident on the pivot, or if the pivot is loose or not perpendicular to the plate. If the pivot is in good condition, install new contacts to obtain correct pivot fit.

8. Assemble the contacts, capacitor, and primary lead on the plate. The distributor lever spring and connector should be installed on the inside of the terminal.

9. Place a drop of oil (OE 10) on the distributor lever pivot pin. Operate the lever once or twice and remove excess oil.

(*e*) *Primary connector and capacitor* (22 and 24).

1. Clean the connector with a cloth dampened with cleaning solvent.

2. Inspect for damaged or corroded connector pin, capacitor, lead, and terminal. Check for grounds with test probes and replace if grounded.

3. Test the capacitor for capacitance and grounds on a conventional tester. Replace the capacitor if grounded, leaky, or if capacitance is less than 2.0 μf.

4. Inspect the gaskets and gasket seats and replace if rough or damaged.

(*f*) *Cam* (11). Clean the cam with solvent (SD) and inspect the cam lobes and weight slots for wear. Replace

the cam if the lobes are grooved or if the sides of the weight slots are rough.

(*g*) *Weights and springs* (15 and 14). Clean the weights (15) and springs (14) in cleaning solvent and dry thoroughly. Replace the weights if the pivot holes are worn or fit loosely on the pivot. Replace the spring if bent or distorted.

(*h*) *Base and shaft* (46 and 45).

1. Wipe the shaft and the inside of the base as clean as possible with a cloth dampened with cleaning solvent. Do not soak. Dry immediately with clean, dry, compressed air.
2. Inspect the base for cracks or other damage. Make sure the groove for the cap seal ring is smooth and clean. Remove the plug in the side of the base and examine the felt wick for damage. If damaged, replace with a new wick which has been soaked in oil (OE). Fill the wick cavity with grease (GL) and insert the wick. Wipe off excess grease. Install the plug.
3. Clamp a dial indicator on the base with the plunger resting against the side of the shaft. With a spring scale, apply a 5-pound pull in line with the plunger. Install a new drive shaft bearing if the side play is more than .005 inch.
4. Clamp the dial indicator on the base with its plunger against the end of the shaft. Move the shaft to its two extreme positions and read the end play. End play can be measured with a flat feeler gage inserted between the shaft collar and the lower thrust washer. If the end play is less than .003 inch, tap the lower end of the shaft to loosen. If the end play is more than .010 inch, remove the collar and install additional thrust washers between the base and the gear.
5. If it is necessary to repair the drive shaft, remove the rivet (40) and take the collar (42) off the shaft. Take off the lower thrust washer (43) and remove the burr from the rivet hole in the shaft. Pull the shaft out of the base and remove the upper thrust washer (44), oil seal, and cork gasket. Drive out the old bearings in the base with an arbor or bolt that rests on the bearings without gouging the bearing bore. Press new bearings into place. Install the lower bearing flush with the bottom of the base and install the upper bearing flush with the face of the bearing bore. Continue the oil hole in the base through the new bearing, using a drill of the same diameter. Remove all burrs from inside of the bearing. Be careful not to mar the bearing. Soak the bearings in oil (OE 30) and drain off excess oil. Do not get oil in the upper part of the base. Install the cork gasket and the oil seal in the base. If the shaft is removed, assemble the governor and install the cam. Grease the upper thrust washer with grease (GL) and install the shaft. Place the shaft in the bearings and install the lower thrust washer and collar. Drill the rivet hole in the shaft to correspond with the hole in the collar and install the rivet. Check side and end play of the shaft.

Note. A cross-sectional view of the ignitor assembly is shown in figure 30.

(3) *Reassembly.* After cleaning and inspection, reassemble the igniter assembly as follows:

(*a*) Place a small amount of grease (GL) on the weight pivot pins, weight pivot holes, cam yoke slots, and weight spring lug pins. Place the governor weights (15) in position and install the governor springs (14) on the weight pins. Make sure the springs are seated properly on the weight pins and plate.

(*b*) Apply a film of oil (OE 30) to the upper end of the drive shaft (45).

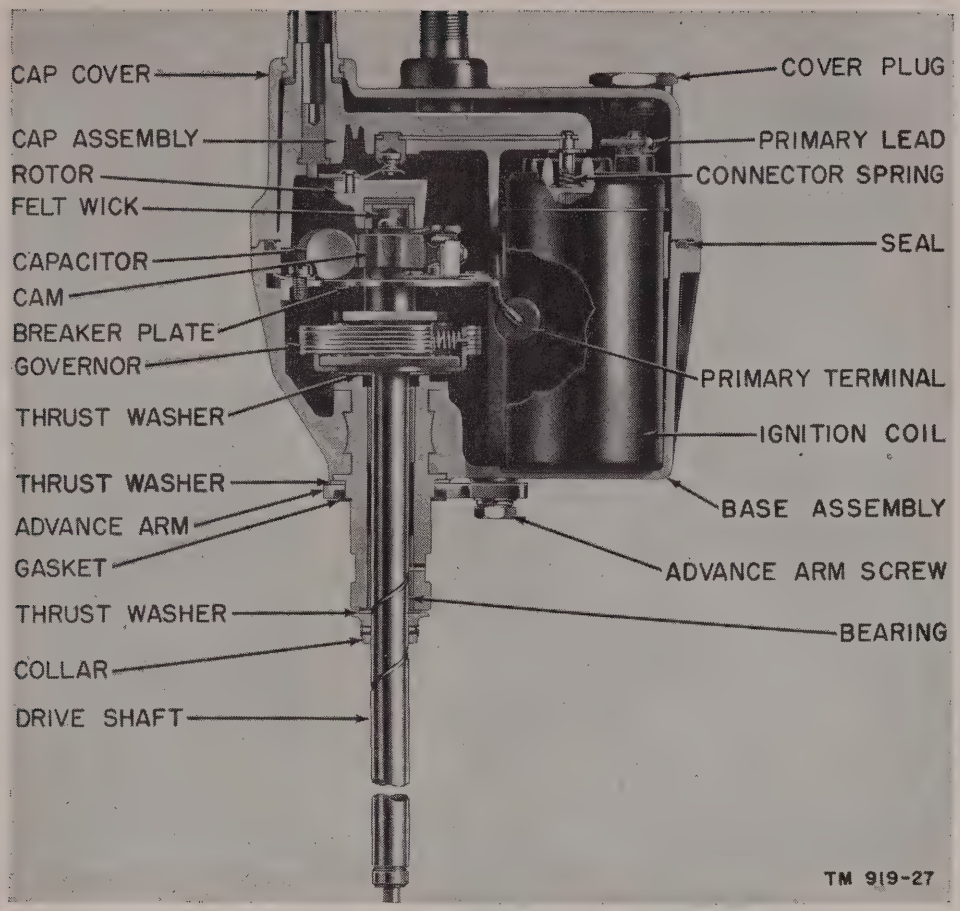


Figure 30. Igniter assembly, cross-sectional view.

Place the cam (11) in position over the shaft and weights. Place the rotor (3) on the cam and check the relation between the rotor and the drive tongue. If not correct, lift the cam and turn 180°. Remove the rotor. Install the cam snap ring (10) and the felt wick (9). Apply 5 to 10 drops of oil (OE 30) to the wick.

(*c*) Place the breaker plate (8) in the base. Turn it so that the locating lug fits into the slot. Install the plate mounting screws and clamps.

(*d*) Install the primary connector (22), gasket (23), capacitor (24), and gasket (25) in position on the base and inspect to insure a tight fit.

(*e*) Place the ignition coil (5) in position in the base and arrange the leads so that they will reach the coil terminals without kinking or cramping. Install the coil mounting screws (4) and the primary lead retaining clips.

(*f*) Adjust the contact gap as follows: Turn the shaft so the distributor lever rubbing block is on the high point of the cam. Loosen the stationary contact lockscrew slightly. Adjust the gap to .020 inch by turning the adjusting cam. To adjust the contact gap, use a wire feeler gage since there is less chance for error than with a flat gage. Tighten the lockscrew. Turn the shaft until the contacts close. Bend the stationary contact bracket to aline the contacts for full-face contact. Readjust the gap after alining the contacts.

(*g*) Adjust the contact pressure as follows: Hook a spring scale on the lever at the contact. Take a reading as the contacts separate. Adjust the tension to 17 to 20 ounces by loosening the screw that holds the contact lever spring. Slide the spring in or out, as necessary. Tighten the screw and check the pressure.

(*h*) Place the rotor (3) on the cam (11) and press down firmly. Turn the leads so as not to interfere with the rotor.

(*i*) Install the seal ring (47) in the groove of the base (46). Install the coil-contact spring (29) on the distributor cap connector pin. Place the cover (1) on the base. Make sure that the spring enters the coil high-tension terminal and that the seal ring is in its proper place. Make sure that the leads are not pinched between the cover and the base. Install the attaching screws (2) and tighten evenly and thoroughly.

(*j*) To check for leaks, connect an air hose to one of the ventilating holes in the base and install plugs in the other holes. Apply 6 pounds of air pressure and submerge the unit in water. If bubbles occur at any point except around the drive shaft, the leak must be eliminated.

i. Starting Motor (fig. 31). After the starting motor has been removed (par. 53*m*), proceed as follows:

(1) *Disassembly.*

(*a*) Remove the cotter pin (1) and slip out the link pin (2) that connects the yoke (27) to the solenoid switch (10). Remove the nut (3) and lock washer (4) that secures the connector strap (7) to the frame (18). Remove the screws (8) and lock washers (9) that secure the solenoid switch to the frame. Then remove the solenoid switch and the connector strap.

(*b*) Remove the brush cover band (11) and take the screws (12) and lock washers (13) out of the commutator end head assembly (15). Lift the brushes (14) out of the brush holders (fig. 32). Slip the commutator end head assembly away from the frame.

(*c*) Remove the frame (18) by removing the screws (16) and lock washers (17). Slip the frame away from the armature (30). Remove the cotter pin (19) and yoke pin (20). Then remove the screws (21) and lock washers (22) and pull the armature away from the pinion housing (31). Slide the thrust washers (28 and 29) from the armature shaft.

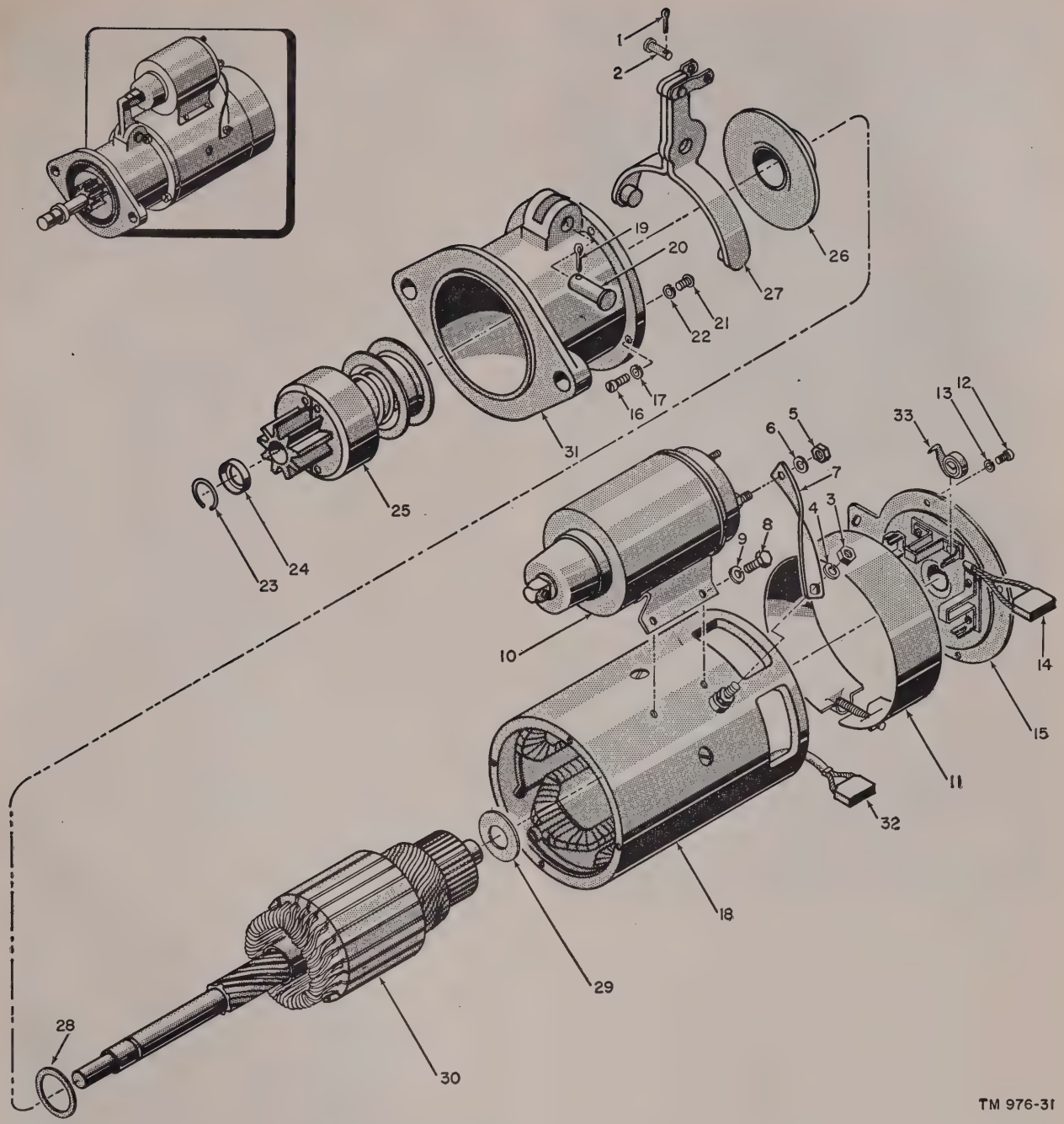
(*d*) Drive the pinion stop and the retainer (24) down on the shaft (toward the spline) and remove the snap ring (23) from the groove. Slip the overrunning clutch (25) and the intermediate bearing assembly (26) from the shaft.

(2) *Cleaning and inspection.* Clean all the starting motor parts and inspect for abnormal conditions as instructed below:

(*a*) *Brushes* (14 and 32).

1. The brushes should slide freely in their holders and make full contact on the commutator. Worn brushes must be replaced.

2. To replace the brushes (14) which have leads connected to the brush holder, the terminal must be unclinched and unsoldered. The new brush leads must be clinched tightly in the terminal, and then soldered to make a strong, low-resistance connection. Brushes (32) soldered to the field coil must be unsoldered and the loop in the field coil must be opened. Insert the new brush pigtail to its full depth in the loop and then clinch before resoldering. A good soldering job must be done to insure no loss of efficiency because of poor contact.



1 Cotter pin
2 Link pin (H564)
3 Nut
4 Lock washer
5 Nut
6 Lock washer
7 Connector strap (E24)
8 Screw
9 Lock washer
10 Solenoid switch (L1)
11 Brush band (A 58)
12 Screw
13 Lock washer
14 Ground brush (E30 and E31)
15 Commutator end head assembly (E29)
16 Screw
17 Lock washer
18 Frame (E26)
19 Cotter pin
20 Yoke pin (H567)
21 Screw
22 Lock washer
23 Snap ring (H565)
24 Pinion stop and retainer (H566)
25 Overrunning clutch (O 134)
26 Intermediate bearing assembly (O 135)
27 Yoke (H568)
28 Thrust washer (H569)
29 Thrust washer (H570)
30 Armature (E25)
31 Pinion housing (A 57)
32 Brushes (E27 and E28)
33 Brush springs (O 136 through O 139)

Figure 31. Starting motor, exploded view.

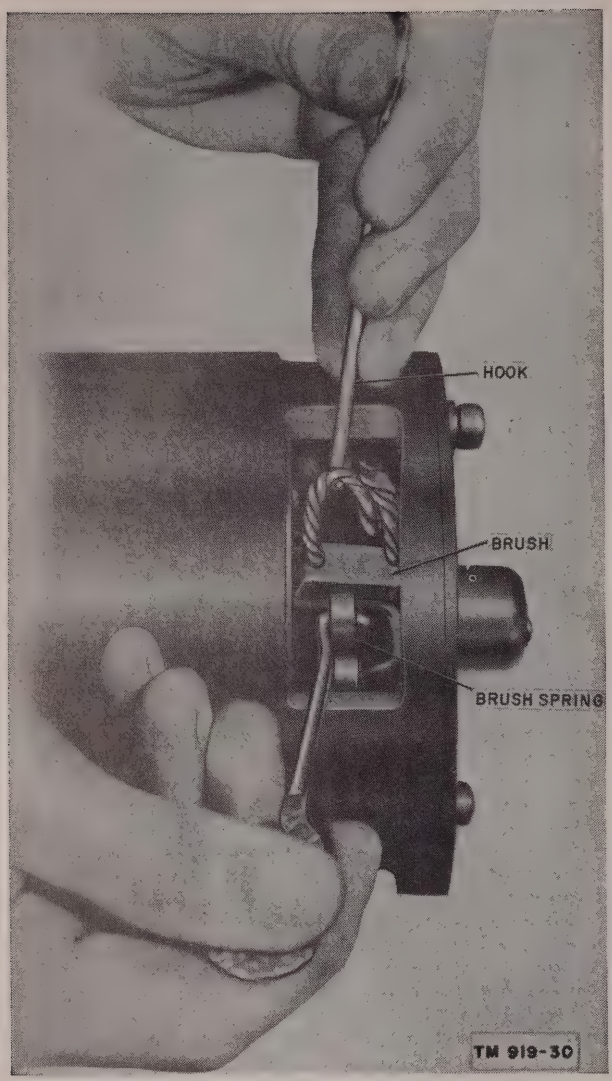


Figure 32. Removing brushes, starting motor.

3. To check the tension of the reaction-type brush springs (33), hook a scale under the brush spring near the brush and pull on a line parallel with the side of the brush (fig. 33). Take the reading just as the spring leaves the brush. The brush spring tension should be between 2.6 to 3.2 pounds (42 to 53 oz.). If the brush spring tension is too low, a loss of efficiency will be caused by poor brush contact. If the tension is too great, the commutator and brushes will wear excessively and have short life. It is important, therefore, that the brush spring tension be kept within the specified limit. To change the spring tension, use long-nosed pliers and twist the spring at the holder.

4. Using test probes, touch each insulated brush holder with one probe, and a convenient ground on the commutator end plate with the other probe (fig. 34). If the lamp lights, a ground is indicated and the brush holder must be replaced.

(*b*) *Armature* (30).

1. Check the commutator for wear or discoloration. If the commutator is only slightly dirty or discolored, it can be cleaned with No. 0000 sandpaper. Blow the sand out of the motor after cleaning the commutator. If the commutator is rough or worn, the armature should be removed and the commutator turned down in a lathe. Visually inspect the armature for mechanical defects.

2. Test the armature for grounds with a set of test probes. Touch one probe to a commutator segment and touch the core or the shaft with the other probe. Do not touch the points to the bearing surfaces or to the brush surface because the arc formed will burn the smooth finish. If the lamp lights, the coil connected to the commutator segment is grounded.

3. To test for a shorted armature coil, place the armature against the core of a growler and hold a steel strip on the armature. Then rotate the armature slowly by hand. If a coil is shorted, the steel strip will become magnetized and vibrate.

(*c*) *Field coils.*

1. Use test probes and check the field coils for grounds. Place one probe on the starting motor frame or pole piece and touch the other probe to the field coil terminals. If a ground is present, the lamp will light.

2. Inspect all connections to make sure they are clinched and soldered

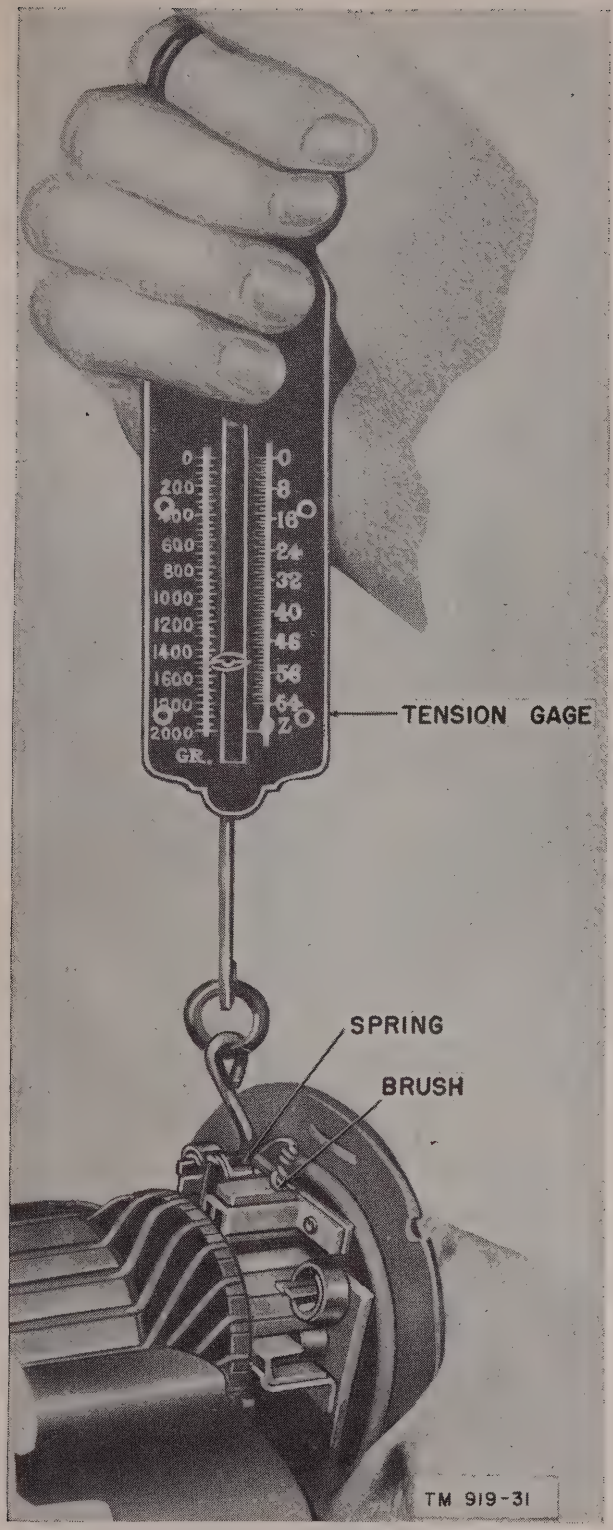


Figure 33. Measuring brush spring tension starting motor.

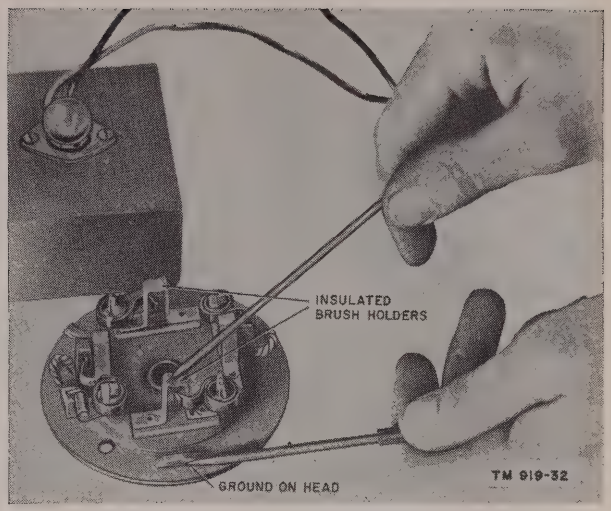


Figure 34. Testing brush holder for grounds (starting motor).

properly. Inspect the insulation for evidence of damage.

(*d*) *Pinion housing* (31). Inspect the housing for cracks and the bearings for wear.

(*e*) *Overrunning clutch* (25). Clean with fuel oil (D–40 or D–35) and examine for wear.

(3) *Reassembly.* After cleaning and inspection, reassemble the starting motor as follows:

(*a*) Wipe the pinion end of the armature shaft with oil (OES). If the absorbent bronze bearings have been removed, soak them in oil (OES) before assembling in the bearing bore. Slip the thrust washer (28), intermediate bearing assembly (26), overrunning clutch (25) onto the armature shaft. Slip on the retainer and pinion stop (24) and secure with the snap ring (23).

(*b*) Hold the yoke (27) in position and secure the pinion housing (31) to the intermediate bearing assembly with the screws (21) and lock washers (22). Secure the yoke to the pinion housing with the yoke pin (20) and cotter pin (19). Slip the frame (18) over the armature (30) and secure with the screws (16) and the lock washers (17).

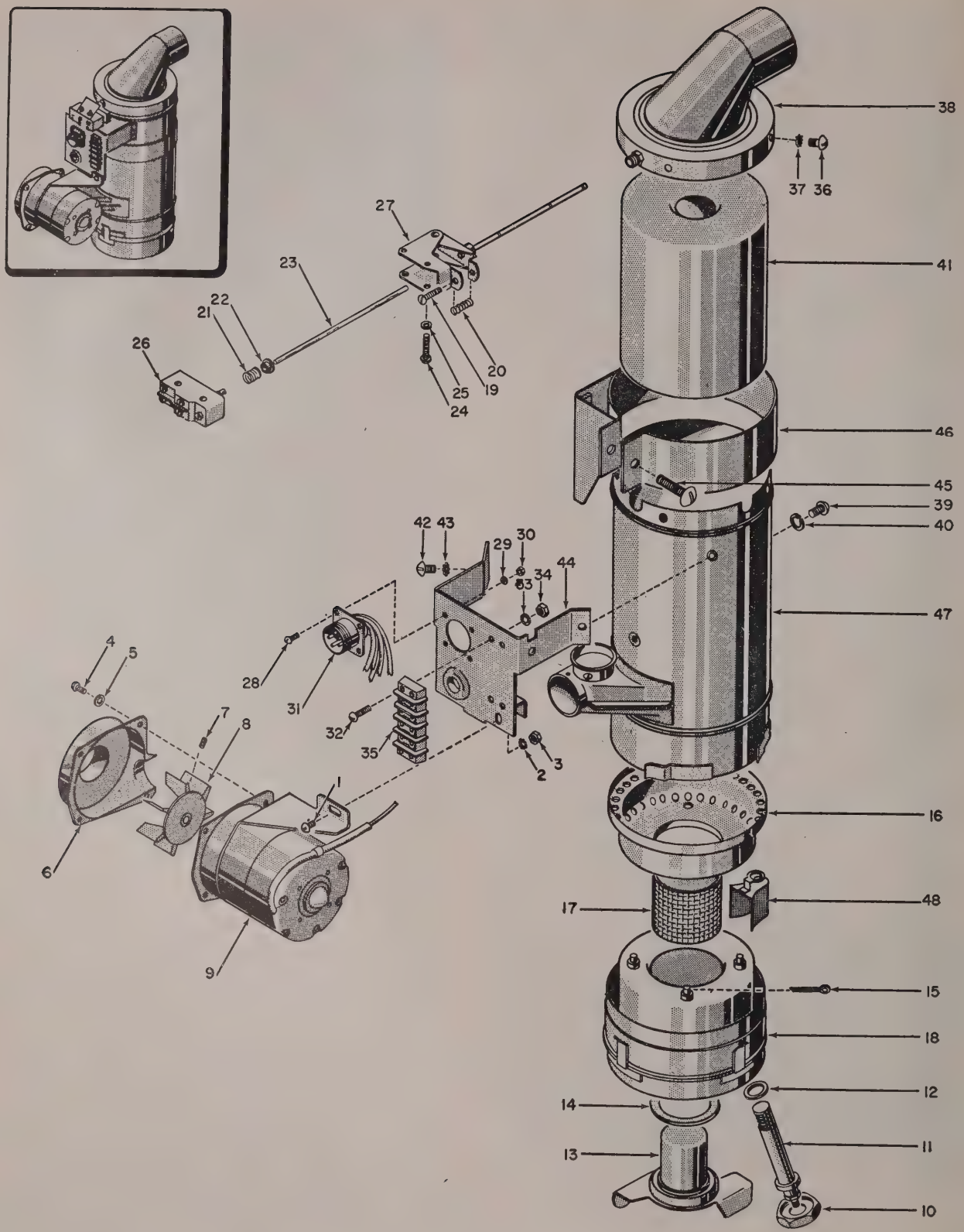


Figure 35. Heater, exploded view.

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(*c*) Apply a few drops of oil (OE 10) to the felt pad in the commutator end head assembly (15). If the absorbent bronze bearing has been removed, soak it in oil (OE 10) and assemble, using correct size arbor to insure proper bearing fit. Secure the commutator end head assembly to the frame with screws (12) and lock washers (13). Proper brush seating should be insured by sanding the brush to fit the commutator. Wrap a strip of No. 0000 sandpaper around the commutator with the abrasive side facing the brushes. Turn the armature slowly in the direction of rotation. Blow the abrasive out of the motor after sanding. Secure the brush band (11).

(*d*) Secure the solenoid switch (10) to the frame. Attach the yoke (27) to the switch with the link pin (2) and cotter pin (1). Secure the connector strap (7) to the frame and switch. After installing the switch, press the switch plunger (not the yoke lever) to shift the pinion into the full mesh position. Adjust the clearance between the pinion and the pinion stop from three-thirty second inch to one-sixteenth inch by screwing the plunger link screw in or out as needed.

j. Heater (fig. 35). After the heater has been removed (par. 53*n*(1)), proceed as follows:

(1) *Disassembly.*

(*a*) To remove the blower unit, disconnect the blower lead wire from the heater terminal block (35). Remove the mounting bracket screw (1) from the terminal block mounting plate (44). Remove the four screws (4) that secure the right half scroll (6). Loosen the setscrew (7) and slide the blower wheel (8) off the blower motor shaft. Do not further disassemble the blower motor (9) because critical clearances are maintained between the motor and scroll assembly.

(*b*) Disconnect the wires from the electrode (11) and the resistor (13). Disengage the locking lever on the burner bowl (18) by rotating the bowl counterclockwise. The burner assembly then will drop out of the heater. Remove the electrode (11) by loosening the locknut (10). Remove the resistor (13) by turning it counterclockwise. Remove the cotter pins (15) and lift off the burner throat (16). Remove the igniter shield (48). Slip the igniter wick (17) upward over the igniter tube in the burner bowl.

(*c*) Disconnect the electrical leads on the flame switch (26) from the terminal

---

1 Screw
2 Lock washer
3 Nut
4 Screw
5 Lock washer
6 Right half scroll (A 122)
7 Setscrew
8 Blower wheel (O 152)
9 Blower motor (B2)
10 Locknut
11 Electrode (E15)
12 Gasket (H682)
13 Resistor (R13)
14 Gasket (H680)
15 Cotter pin
16 Burner throat (A 119)
17 Igniter wick (H681)
18 Burner bowl (A 123)
19 Adjusting screw
20 Adjusting spring (O 151)
21 Spring (O 150)
22 Spring retainer (H676)
23 Quartz rod (H677)
24 Screw
25 Lock washer
26 Flame switch (S12)
27 Bracket and tube assembly (A 114)
28 Screw
29 Lock washer
30 Nut
31 Receptacle (J7)
32 Screw
33 Lock washer
34 Nut
35 Terminal block (TB5)
36 Screw
37 Lock washer
38 Top cover (A 115)
39 Screw
40 Lock washer
41 Heat exchanger (A 116)
42 Screw
43 Lock washer
44 Terminal block mounting plate (A 121)
45 Screw
46 Heater mounting bracket (A 117)
47 Combustion chamber (A 118)
48 Igniter shield (A 120)

Figure 35—Continued.

block. Back off the switch mounting nut and remove the assembly from the top of the heater. Remove the adjusting screw (19) and the adjusting spring (20). Open the bracket on the bracket and tube assembly (27). The spring retainer (22) and spring (21) will fall out. Carefully remove the quartz rod (23); it is extremely brittle. Remove the mounting screws (24), lock washers (25), and switch.

(*d*) Disconnect the remaining wires on the terminal block (35). Remove the screws (28) and the receptacle (31). Then remove the screw (32) and the terminal block.

(*e*) Take off the heater top cover (38) by removing the screws (36) and lock washers (37). Loosen the heat exchanger (41) by removing the screws (39). Lift the heat exchanger out of the combustion chamber (47).

(2) *Cleaning and inspection.* Clean the carbon deposits from the burner, resistor, combustion chamber, throat, top cover, and flame switch rod. Blow out loose deposits with compressed air. Inspect all the heater parts for abnormal conditions as instructed below.

(*a*) After reassembly ((3) (*e*) below) check the blower assembly with a storage battery of 12 volts and a stroboscopic type of speed measuring instrument. If the blower wheel does not turn at least 5,000 rpm, replace the entire assembly.

(*b*) Inspect the air holes in the burner throat (16). If they are plugged, clean them with a pipe cleaner or wire. The igniter wick (17) should be replaced if charred or burned to a point one-quarter inch below the top edge of the igniter tube in the burner bowl (18).

(*c*) Check the interior of the heat exchanger (41) for bulges or cracks. Examine the combustion chamber (47) and top cover (38) for dents and cracks.

(*d*) After reassembly ((3) (*c*) below), check the flame switch (26) operation by loosening the two mounting screws (24) and the adjusting screw (19). Operate the switch manually by pressing the switch toward the heater and releasing. Check the continuity of circuits through the switch with a test lamp and prods or with an ohmmeter. Inspect the quartz rod (23) for breakage.

(*e*) Check the electrode (11) for proper operation as follows: Using a 6-volt battery, clamp the battery negative cable on the electrode terminal and the battery positive cable to ground. The electrode coil should turn cherry red immediately.

(*f*) To test the resistor (13), connect it in series with a good electrode. A resistor and electrode checked with 12 volts should draw 10 to 12 amperes from a good battery. If the combination does not draw 10 to 12 amperes, replace the resistor.

(3) *Reassembly.* After cleaning and inspection, reassemble the heater as follows:

(*a*) Slip the heat exchanger (41) into the combustion chamber (47) and secure it with the screws (39) and lock washers (40).

(*b*) Secure the receptacle (31) to the plate (44) with the screws (28), lock washers (29), and nuts (30). Then secure the terminal block (35) with the screws (32), lock washers (33), and nuts (34). Connect the wires as shown in figure 64.

(*c*) Secure the switch (26) with screws (24) and lock washers (25). Insert the quartz rod (23) into the bracket and tube assembly (27). Slip the spring retainer (22) and spring (21) over the switch plunger. Close the bracket and position the adjusting spring (20). Secure the spring

with the adjusting screw (19). Insert and secure the flame switch assembly in the top cover (38). (Adjust the flame switch as instructed in paragraph 62*g*(2).) Then install the top cover on the combustion chamber with the screws (36) and lock washers (37). Connect the wires as shown in figure 64. Check the operation of the flame switch ((2) (*d*) above).

(*d*) Slip the igniter wick (17) over the igniter tube in the burner bowl (18). Secure the burner throat (16) to the burner bowl with the cotter pins (15). Position the gasket (14) over the resistor (13) and insert the resistor into the burner bowl. Position the gasket (12) on the electrode (11) and insert the electrode in the bowl. Be sure the index button on the electrode is inserted in the groove in the burner bowl. Install and tighten the locknut (10). Insert the assembled burner bowl in the combustion chamber and rotate it clockwise to secure it. Connect the resistor and electrode wires.

(*e*) Slide the blower wheel (8) on the blower motor shaft and secure it with the setscrew (7). Secure the right half scroll (6) to the blower motor (9) with the screws (4) and lock washers (5). Secure the motor ground strap to the scroll halves. Attach the assembly to the terminal block mounting plate (44) with the screw (1), lock washer (2), and nut (3). Connect the blower motor wire to the terminal block. Check the operation of the blower assembly ((2) (*a*) above).

k. Heater Fuel Pump (fig. 36). After the heater fuel pump has been removed (par. 53*n*(3)), proceed as follows:

(1) *Disassembly.*

(*a*) Apply a wrench to the nut on the bottom of the cover and remove the cover. Then carefully remove the screen.

(*b*) Remove the three screws and lift out the spring cup, gasket, plunger spring, and plunger. Do not remove the buffer spring or valve assembly from the plunger. Do not remove the valve assembly from the spring cup.

(2) *Cleaning and inspection.* Clean all the heater fuel pump parts and inspect for abnormal conditions.

(*a*) Clean the cover in cleaning solvent and blow dry with compressed air. Examine the cover for cracks or dents. Replace the cover gasket.

(*b*) Thoroughly clean the screen in cleaning solvent. If the screen is badly distorted or collapsed, replace it.

(*c*) Clean the plunger and spring cup with cleaning solvent. Do not use compressed air on these parts. Check the plunger fit by slowly rais-

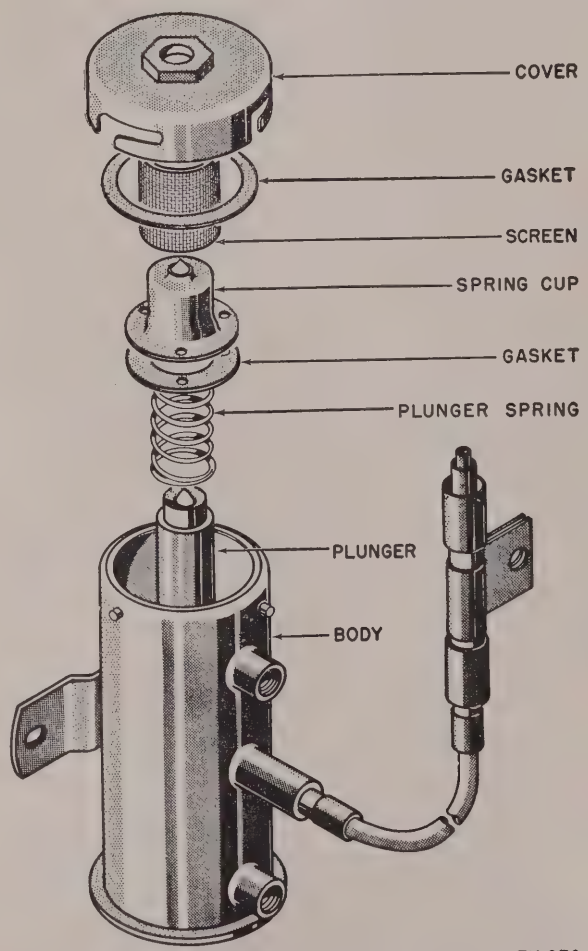


Figure 36. Heater fuel pump, exploded view.

ing and lowering the plunger in the cylinder. It should move freely without any tendency to stick. If the interrupter system is functioning properly, a click will be heard each time the plunger approaches the top of the cylinder.

(*d*) Flex the plunger spring and examine for cracks.

(*e*) Wash the pump body in cleaning solvent and blow out the cylinder with compressed air. Wipe dry with a piece of cloth the inside of the body.

(3) *Reassembly.* After cleaning and inspection, reassemble the heater fuel pump as follows:

(*a*) Insert the plunger in the cylinder with the buffer spring end first.

(*b*) Install the plunger spring over the plunger. Then install the spring cup gasket and the spring cup. Turn the fastening screws reasonably tight to insure a good seal, but avoid distorting the spring cup.

(*c*) Position the cover gasket in place. Seat the screen in the cover and then carefully guide the screen around the spring cup. Use a wrench to turn the cover to closed position.

55. Fits and Tolerances

This paragraph contains a table of fits and tolerances required to repair or overhaul Power Unit PU–26A/U. The minimum and maximum columns in the table in *a* below indicate the minimum and maximum tolerances for parts to be continued in use. Parts not conforming to the limits specified should be replaced. The table of fits and tolerances follows:

a. Clearances.

Item	Dimensions (in.)	
	Minimum	Maximum
Engine bearings:		
Main bearings	.0014	.0029
Connecting-rod bearings	.0005	.0025
Camshaft bearings	.001	.0025
Pistons and rings:		
Piston-to-cylinder wall clearance.	.003	.003
Piston-pin clearance in piston	.0001	.0009
Oil-ring gap	.008	.013
Compression-ring gap	.008	.013
Piston-ring land clearance	.0005	.0015
Valves:		
Intake-valve-stem clearance in guide.	.0015	.00325
Exhaust-valve-stem clearance in guide.	.0025	.0045
Valve-tappet clearance (engine cold).	.016	.016
Valve-tappet clearance in guide.	.0005	.002
Valve seat out-of-round	.000	.002
End play and backlash:		
Crankshaft end play	.004	.006
Camshaft end play	.003	.0055
Main-bearing side play	.004	.008
Connecting-rod side play	.004	.010
Crankshaft gear to camshaft gear backlash.	.000	.002
Distributor-shaft end play	.003	.010
Distributor-shaft side play	.001	.005
Starter armature end play	.005	.030
Oil pump:		
Clearance between rotor lobes	.000	.010
Outer rotor and pump body clearance.	.000	.012
Gear clearance in body	.003	.010
Inner surface of cover out-of-flat.	.000	.001
Miscellaneous:		
Cylinder out-of-round	.000	.005
Flywheel runout	.000	.008
Spark plug gap	.030	.030
Breaker point gap	.020	.020
Concentricity of flywheel housing with flywheel.	.000	.003
Face of flywheel housing with flywheel.	.000	.003

b. Spring Pressures.

Item	Free length (in.)	Deflection or compression (in.)	Pounds
Valve springs	2½	Compressed to 2 7/64	53
		Compressed to 1¾	124
Governor control arm spring.	2⅝	Deflected ¼	38–46
		Deflected ½	70
Starting motor brush springs.			2.6–3.3
Generator commutator springs.			1.87–2.5
Generator slip-ring brush springs.			1–1.25

c. Wrench Tension.

Item	Foot-pounds
Cylinder-head nuts	60–65
Intake and exhaust manifold nuts	31–35
Main-bearing cap screws	65–70
Connecting-rod nuts	35–40
Oil pan bolts	10–14
Flywheel nuts	36–40

Section II. DISASSEMBLY

Note. The following instructions apply to disassembly of the generator and engine after the unit has been stripped in accordance with instructions in paragraph 53.

56. Disassembly of Generator

a. Removal of End Bell Assembly (fig. 37).

(1) Remove the brush cover assembly (1) from the end bell (2).

(2) Disengage the exciter leads (3) from the brush holder assembly (4). These leads are accessible through the end bell openings.

(3) Remove the brush spring assemblies (5, 6) and pull the slip ring brushes (7) and commutator brushes (8) out of the brush holder. This will prevent possible damage to the slip-ring insulation during removal of the end bell.

(4) Remove the bolts (9) and washers (10) from the bearing cover plate (11). Remove the bolts (12), lock washers (13), and washer (14) which are used to secure the end bell to the stator housing (15). Install the puller bolt (supplied with the unit) into the center-tapped hole of the bearing cover plate. Turn the puller clockwise until the end bell breaks loose (fig. 38). Slowly pull the end bell away from the stator housing. Be careful not to damage the brush holder assembly and the slip-ring insulation. Remove the bolts (16) and washers (17) and remove the bearing cover plate.

(5) Remove the nut (18), lock washer (19), and flat washer (20). Remove the screw (21) and lock washer (22) and remove the brush holder assembly (14) and the capacitors (23) from the end bell.

(6) Clean the end bell with fuel oil (D–40 or D–35) or cleaning solvent and examine it thoroughly for cracks.

(7) Inspect the complete brush holder assembly for corrosion and wear. Check for free movement of the brushes in the brush holders. Check the length of the brushes. Brushes worn to less than one-half inch long must be replaced. Check the brush spring tension. Hook a scale under the spring near the brush and pull in a line parallel with the side of the brush. The tension reading should be taken just as the spring leaves the brush. Tension of the commutator brush spring should be 30 to 40 ounces; tension of the slip-ring brush spring should be 16 to 20 ounces.

(8) New brushes must be seated correctly to the commutator and slip ring. Place a strip of No. 0000 sandpaper, sanded side out, around the commutator or slip ring. With the brushes riding on the sandpaper under normal spring tension, hold the two sides of the sandpaper parallel to each other and pull in the normal direction of the commutator rotation. Repeat this procedure until correct seating is attained for all new brushes.

(9) Test the four capacitors (23) for shorts with an ohmmeter.

b. Removal of Exciter Field Ring (fig. 37).

(1) Heat the stator housing (15) around the exciter field ring assembly (24). Insert a screw driver between the

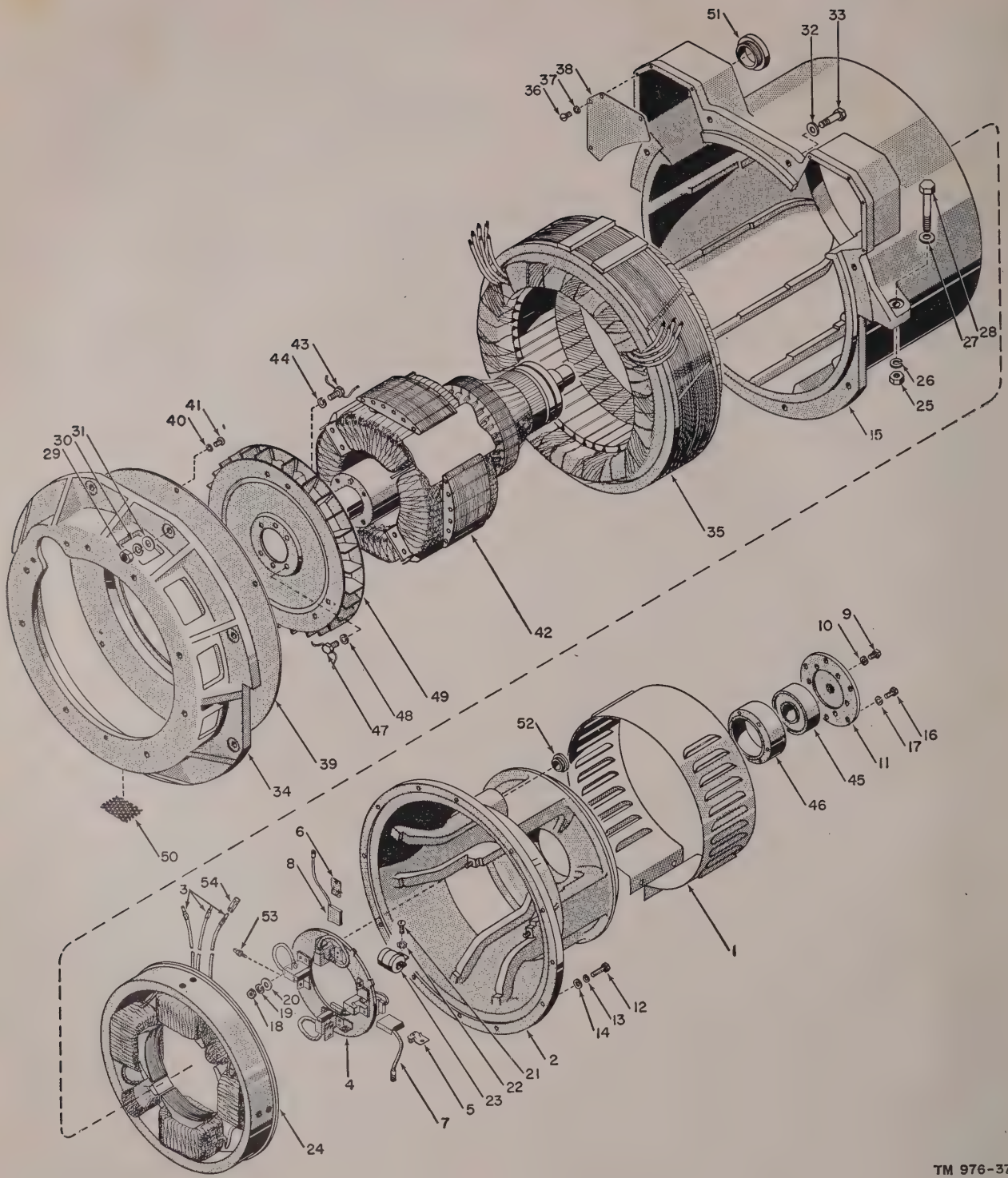


Figure 37. Generator, exploded view.

1 Brush cover assembly (A 64)
2 End bell (A 63)
3 Exciter field ring leads
4 Brush ring and holder assembly (E39)
5 Commutator brush spring assembly (H586 through H589)
6 Slip-ring brush spring assembly (H577 through H580)
7 Commutator brushes (E40 through E43)
8 Slip-ring brushes (E34 through E37)
9 Screw
10 Lock washer
11 Bearing cover plate (A 66)
12 Screw
13 Lock washer
14 Flat washer
15 Stator housing (A 62)
16 Screw
17 Lock washer
18 Nut
19 Lock washer
20 Flat washer
21 Screw
22 Lock washer
23 Capacitor (C13 through C16)
24 Exciter field ring assembly (E38)
25 Nut
26 Lock washer
27 Flat washer
28 Bolt
29 Nut
30 Lock washer
31 Flat washer
32 Flat washer
33 Bolt
34 Flywheel housing (A 61)
35 Stator (E33)
36 Screw
37 Lock washer
38 Junction box cover plates (A 59, A 60)
39 Air scroll (A 129)
40 Lock washer
41 Screw
42 Rotor (E32)
43 Screw
44 Lock washer
45 Bearing (O 140)
46 Bearing liner (A 65)
47 Screw
48 Lock washer
49 Blower assembly (A 130)
50 Air vent guard (H590 through H595 and H707 through H709)
51 Stator lead bushing (H571, H572)
52 Exciter field lead bushing (H581)
53 Brush holder connector studs
54 Exciter field lead couplers (H573 through H575)

Figure 37—Continued.

stator housing and the shoulder on the exciter field ring. Pry around the circumference of the exciter field ring and ease the ring out of the stator housing. The exciter field ring assembly can be removed either before or after removal of the stator assembly.

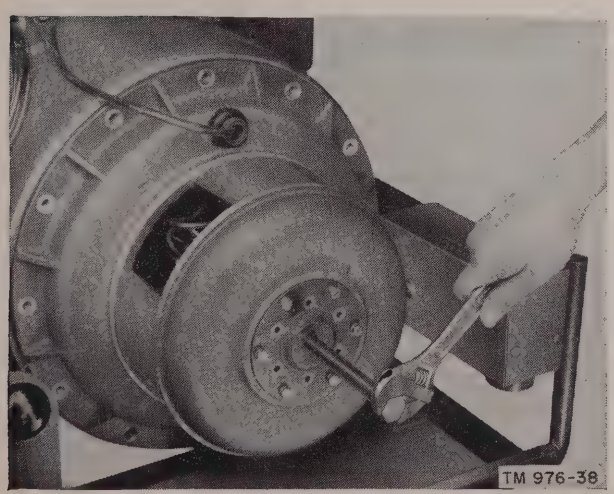


Figure 38. Removing end bell assembly.

Caution: Do not allow the temperature of the stator housing to rise above 180° F.

(2) Check the lacing cord and insulation of the exciter field ring for evidence of wear. Examine the interpoles and pole shoes for corrosion.

(3) Refer to *e*(1) below and test the exciter field ring assembly for continuity, shorts, and ground.

c. Removal of Housing and Stator Assembly (fig. 37).

(1) Remove the heat exchanger pan as instructed in paragraph 53*n*(2).

(2) Loosen the two lower radiator mounting bolts. Then remove the bolt which is used to secure the muffler mounting clamp to the lower frame.

(3) Remove nuts (25), lock washers (26), flat washer (27), and bolts (28) which are used to secure the stator housing to the shock mounts and lower frame. Install the generator lifting eye (supplied with the unit) into the tapped

hole on top of the stator housing. Attach a chain hoist into the lifting eye (fig. 39). Raise the rear of the engine and generator approximately 5 inches, or until the stator housing mounting flange will clear the lower frame crossmember. Place a block of wood under the rear of the oil pan and slowly lower the engine until it rests securely on the block. Remove the nuts (29), lock washers (30), flat washers (31, 32), and bolts (33) that are used to mount the stator housing to the flywheel housing (34). Carefully swing the stator housing away from the unit (fig. 39).

(4) Test the stator (35) for continuity, shorts, and grounds as instructed in *e*(3) below.

(5) Remove screws (36), lock washers (37), and stator junction box cover plates (38). Pull the stator leads out through the bushings. Install two bolts (12) part way into the stator housing. Hook a chain around the two bolts and attach a hoist to the chain. Then raise the stator housing off the ground approximately 1 or 2 inches, and heat the housing with a torch. As the housing is heated it will expand and release the stator assembly.

Caution: Do not allow the temperature of the stator housing to rise above 180° F.

(6) Clean the stator housing with solvent (SD) or fuel oil (D–40 or D–35), and examine it carefully for cracks.

d. Removal of Rotor Assembly (fig. 37).

(1) Remove the air scroll (39) by removing the lock washers (40) and screws (41).

(2) Place a canvas belt around the rotor assembly (42) and attach the belt to a chain hoist. Take up the slack until the belt is taut. Be careful not to put any strain on the rotor. Remove the lockwire, screws (43), and lock washers (44). Then swing the rotor assembly slowly away from the unit (fig. 40).

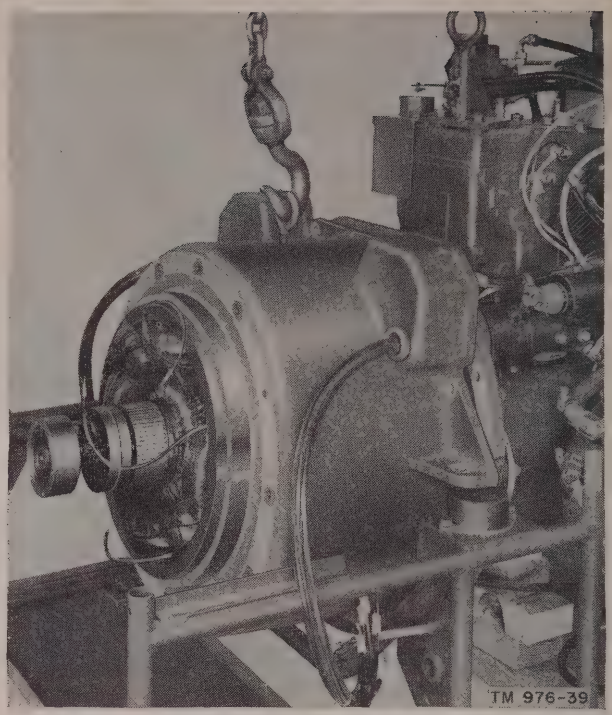


Figure 39. Removing housing and stator assembly.

(3) Remove the bearing (45) and the bearing liner (46) from the rotor shaft with a bearing puller. Tap the bearing out of the liner with a soft piece of wood and a hammer. Clean the bearing liner with cleaning solvent or fuel oil (D–40 or D–35) and examine for scratches and burrs. Wipe the bearing clean with a piece of dry cloth, and rotate slowly a few times to check for binding. If the bearing requires service or repacking, proceed as instructed in paragraph 35*a*.

(4) Test the rotor assembly for continuity, shorts, and grounds as instructed in *e*(2) and (3) below. With the exciter armature in a growler, place a hacksaw blade on the top of the armature. The blade will vibrate and be attracted if the exciter armature is shorted. If a short is indicated, proceed as follows: Move the hacksaw blade down to the two commutator segments directly below, and in line with the point on the exciter armature where the short was indicated. Run a corner of the blade between the segments along

the full length of the mica. Repeat this procedure around the entire commutator, and at the outer end of the segments next to the shaft. This process will remove any particle of metal which might have shorted two segments. If a second test indicates a short, then the short is in the winding or in the commutator segments.

(5) Examine the commutator for roughness, high mica, filled slots, and out-of-round. Generally inspect for any evidence of arcing and wear. The commutator acquires a mahogany-colored surface after a short period of operation. This condition is normal and requires no attention. A slight roughness of the commutator may be eliminated by holding a piece of No. 0000 sandpaper against the surface with the engine operating slowly. The brushes should be pulled out of the holders during this operation. A badly burned or pitted commutator will require refinishing in a lathe. Turn down the commutator segments and slip rings to a smooth surface. Leave the slip-ring insulation approximately one thirty-second inch higher than the slip rings. Undercut the mica insulation between the segments one thirty-second inch.

Caution: Never turn the commutator and slip rings down more than one-eighth inch.

(6) The complete rotor with the blower assembly (49) attached has been statically balanced. To eliminate the necessity of rebalancing the rotor assembly, proceed as follows: Before disassembly, mark the blower assembly and the rotor drive hub with similar alining marks. Then be sure the marks are alined correctly when replacing the blower.

e. Testing Generator. Readings listed in the following subparagraphs are normal, and any deviation indicates faulty equipment. All tests should be made at approximately 68° F. Readings of the ohmmeter in extreme temperatures will vary considerably. When testing an assembled generator with a high potential tester, be sure that all the brushes are out of the holders.

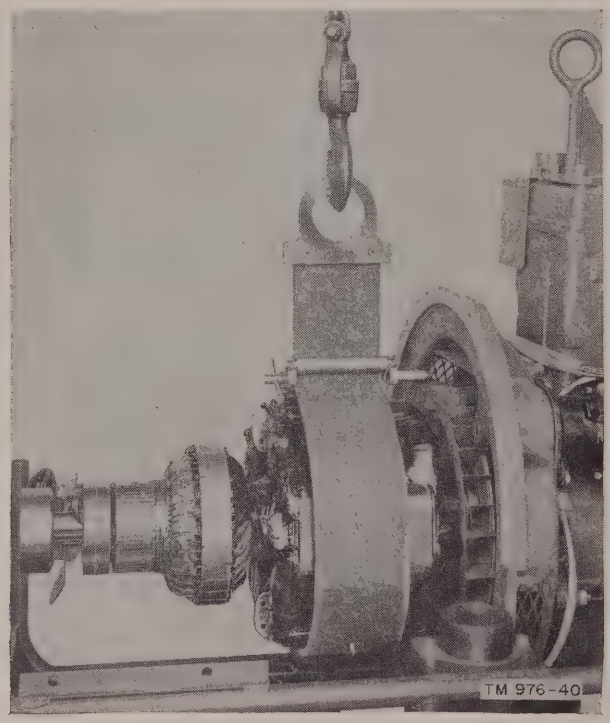


Figure 40. Removing rotor.

(1) *Exciter field ring.*

Type test	Test points	Ohmmeter	High potential tester		Test lamp	Growler
			Setting (V)	Indication		
Continuity	Lead FS to F2	42 ohms	1,500	Light out	Light on	No test
	Lead FS to S2	.36 ohms	1,500	Light out	Light on	No test
Short	Lead FS to S2	.36 ohms	No test	No test	No test	No test
	Lead FS to F2	42 ohms	No test	No test	No test	No test
Ground	Lead FS to exciter frame steel.	Infinity	1,500	Light on	Light off	No test

(2) *Exciter armature.*

Type test	Test points	Ohmmeter	High potential tester		Test lamp	Growler
			Setting (V)	Indication		
Continuity	Segment to segment.	Equal deflection of meter between segments.	1,500	Light out	Light on	Spark each bar.
Short	Segment to segment.	Equal deflection of meter between segments.	No test	No test	No test	No vibration of hacksaw saw blade.
Ground	Segment to rotor shaft.	Infinity	1,500	Light on	Light off	No test

(3) *Stator.*

Type test	Test points	Ohmmeter	High potential tester		Test lamp	Growler
			Setting (V)	Indication		
Continuity	Leads 1 to 4, 2 to 5, 3 to 6, 7 to 10, 8 to 11, and 9 to 12.	.083 ohm per coil.	No test	No test	Light on	No test
Short	Lead 1 to all other leads except 4.	Infinity	1,500	Light on	Light off	No test
	Lead 2 to all other leads except 5.	Infinity	1,500	Light on	Light off	No test
	Lead 3 to all other leads except 6.	Infinity	1,500	Light on	Light off	No test
	Lead 7 to all other leads except 10.	Infinity	1,500	Light on	Light off	No test
	Lead 8 to 9	Infinity	1,500	Light on	Light off	No test
Ground	Steel to leads 1, 2, 3, 7, 8 and 9.	Infinity	2,500	Light on	Light off	No test

(4) *Rotor.*

Type test	Test points	Ohmmeter	High potential tester		Test lamp	Growler
			Setting (V)	Indication		
Continuity	Slip ring to slip ring.	10.6 ohms	No test	No test	Light on	No test
Short	Slip ring to slip ring.	10.6 ohms	No test	No test	No test	No test
Short	Slip ring to commutator.	Infinity	1,500	Light on	Light off	No test
Ground	Slip ring to rotor shaft.	Infinity	1,500	Light on	Light off	No test
Ground	Commutator to rotor shaft.	Infinity	1,500	Light on	Light off	No test

57. Removal of Engine

Before the engine can be removed, remove the generator (par. 56) and the subassemblies (par. 53). When the generator has been removed and the engine has been stripped of all subassemblies and components that would interfere with its removal, disconnect the two ground straps on the front engine mounts and remove the two front engine mounting bolts. Hook a hoist to the engine lifting eye and hoist the engine from the frame (fig. 41).

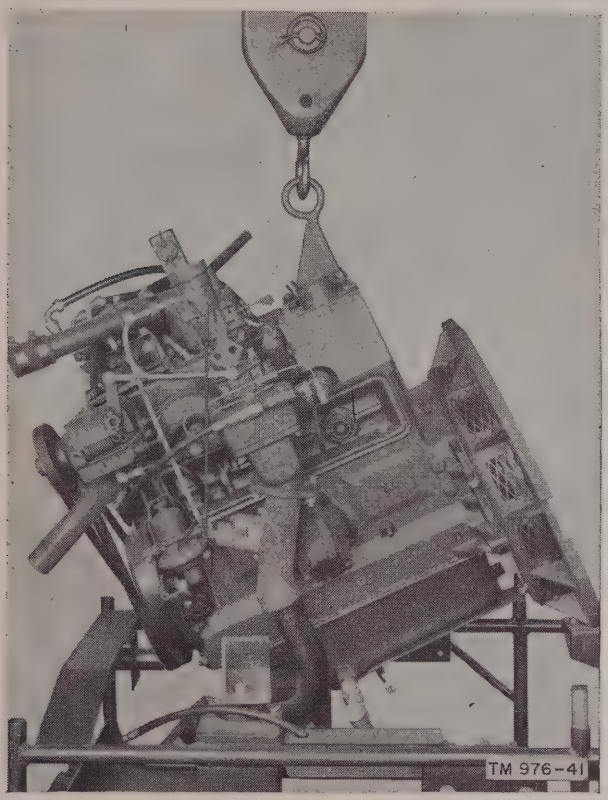


Figure 41. Removing engine from lower frame.

58. Disassembly of Engine

a. Manifolds (fig. 42).

(1) Remove the bolts that are used to secure the intake manifold (1) to the exhaust manifold (3). Remove the nuts that are used to secure the intake manifold to the block and remove the manifold and gasket (2).

(2) Remove the exhaust manifold and the gasket (4).

(3) Clean the carbon out of the manifolds with a wire brush. Blow out loose carbon deposits with compressed air.

(4) Scrape the gasket particles off the manifold flanges.

(5) Examine the manifolds for cracks and warpage.

b. Cylinder Head (fig. 42).

(1) Remove the coolant outlet elbow (5) and the gasket (6). Lift the thermostat retainer (7), thermostat adapter (8), and thermostat (9) out of the outlet elbow. Remove the spark plugs.

(2) Remove the hold-down nuts and pull the cylinder head (10) straight up off the studs. Remove the gasket (11).

(3) Wash the cylinder head with fuel oil (D–40 or D–35) and scrape off gasket particles and carbon.

(4) Examine the cylinder head for dents, cracks, and warpage.

c. Valve Mechanism (fig. 42).

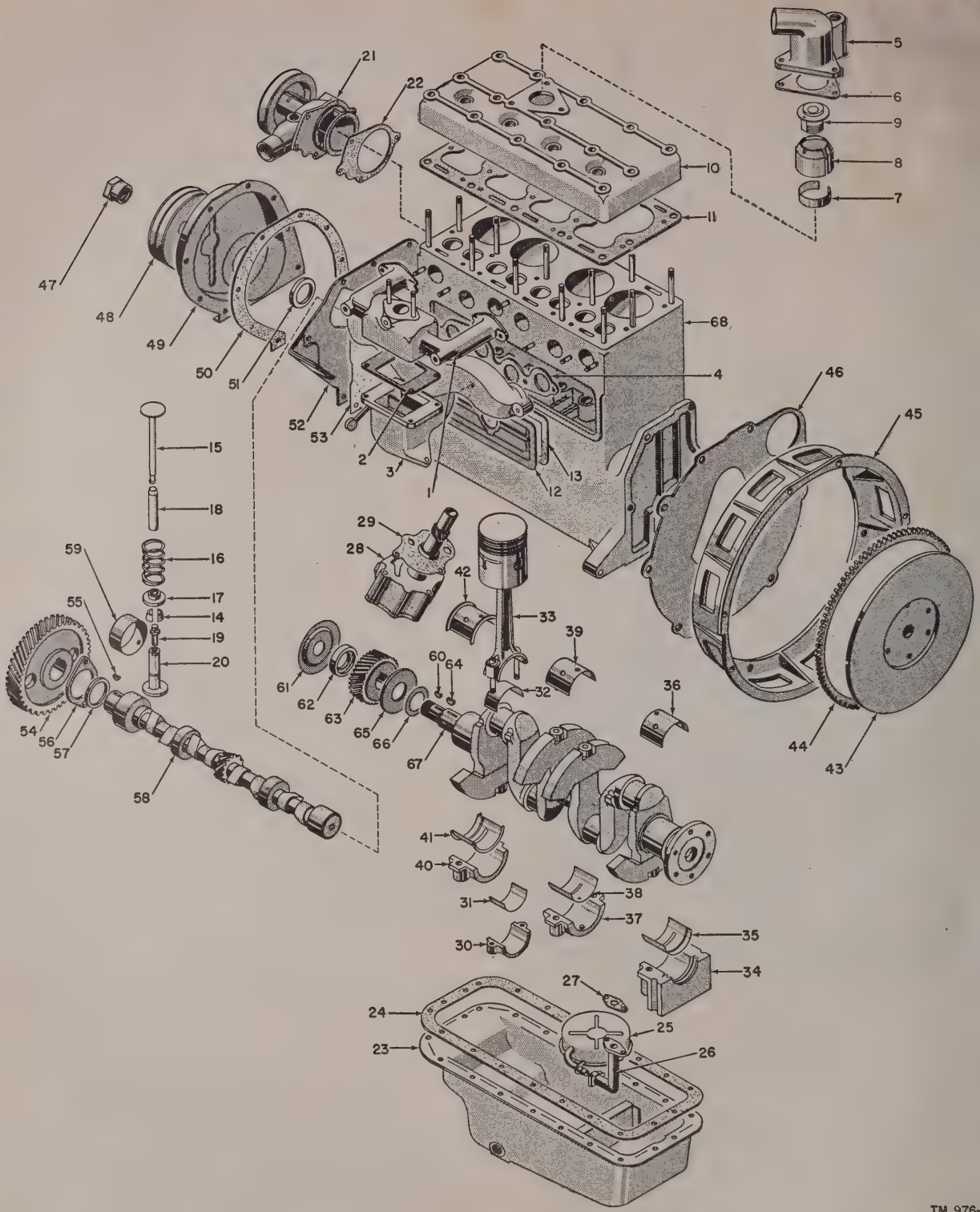
(1) Remove the manifolds as instructed in *a* above.

(2) Remove the cylinder head as instructed in *b* above.

(3) Remove the valve cover plate screws, valve cover plate (12), and the copper gaskets on each screw. Then block off the three holes in the valve chamber floor with cloth to prevent dropping valve locks into the crankcase.

(4) With a spring compressor, raise the springs on the valves which are in closed position (fig. 43), and remove the valve locks (14). Then turn the crankshaft until the open valves become closed and remove the remaining valve locks. Remove the valve rotocaps (17) and keep them with their respective valves.

(5) Remove the valves (15) and place them in a wooden block, drilled and numbered for identification. Clean the valves with a wire wheel brush. Remove carbon from the top and bottom of the valve heads and gun from the stems. Reface the valve heads at an angle of 45°. Reface the seats in



TM 976-42

Figure 42. Engine, exploded view.

1 Intake manifold (A 41)
2 Gasket (H478)
3 Exhaust manifold (A 42)
4 Gasket (H467)
5 Coolant outlet elbow (A 15)
6 Gasket (H181)
7 Thermostat retainer (H200)
8 Thermostat adapter (A 16)
9 Thermostat (O 79)
10 Cylinder head (A 18)
11 Gasket (H213)
12 Valve cover plate (A 43)
13 Gasket (H492)
14 Valve locks (H34 through H41)
15 Valve (O 3 through O 10)
16 Valve spring (O 20 through O 27)
17 Rotocap (H26 through H33)
18 Valve guide (O 16 through O 19)
19 Tappet adjusting screws (H42 through H49)
20 Valve tappet (O 28 through O 35)
21 Water pump assembly (O 56)
22 Gasket (H122)
23 Oil pan (A 49)
24 Gasket (H510)
25 Oil float (A 51)
26 Oil float support (A 50)
27 Gasket (H538)
28 Oil pump (O 132)
29 Gasket (H545)
30 Connecting-rod cap
31 Lower connecting-rod bearing (O 71 through O 74)
32 Upper connecting-rod bearing (O 71 through O 74)
33 Piston and connecting-rod assembly (O 66 through O 69)
34 Rear main-bearing cap
35 Lower rear main bearing (O 70)
36 Upper rear main bearing (O 70)
37 Center main-bearing cap
38 Lower center main bearing (O 70)
39 Upper center main bearing (O 70)
40 Front main-bearing cap
41 Lower front main bearing (O 70)
42 Upper front main bearing (O 70)
43 Flywheel (O 93)
44 Flywheel ring gear (O 94)
45 Flywheel housing (A 61)
46 Rear engine plate (A 34)
47 Crank ratchet (H320)
48 Crankshaft pulley (O 92)
49 Gear cover (A 32)
50 Gasket (H339)
51 Oil seal (H338)
52 Front engine plate (A 33)
53 Gasket (H346)
54 Camshaft gear (O 37)
55 Camshaft gear key (H50)
56 Thrust plate (H58)
57 Thrust plate spacer (H59)
58 Camshaft (O 38)
59 Camshaft bearing (O 36)
60 Crankshaft pulley key (H306)
61 Oil slinger (O 75)
62 Gear spacer (H158)
63 Crankshaft gear (O 76)
64 Crankshaft gear key (H159)
65 Thrust washer (H160)
66 Shim (H161)
67 Crankshaft (O 77)
68 Cylinder block (A 19)

Figure 42—Continued.

the cylinder block and check them with a dial gage. Valve seats should not be out-of-round more than .002 inch. Touch up the valves to the valve seats with a fine grinding compound.

(6) Check the clearance between the valve stems and valve guides (18). Standard clearance between the intake valve stem and valve guide should be .0015 inch to .00325 inch; between the exhaust valve stem and valve guide the clearance should be .0025 inch to .0045 inch. If the clearance is excessive, remove the valve guides with a puller and discard them. If the clearance is standard, clean carbon off the valve guides with a wire brush.

(7) Wash the valve springs (16) in cleaning solvent and examine them for damage or corrosion caused by acid etching. The overall free length of each spring should be measured and the spring pressure checked. The free length should be 2½ inches. The standard spring pressure when compressed to 2 7/64 inches is 53 pounds and when compressed to 1¾ inches is 124 pounds. Replace the springs that do not meet the above specifications.

d. Water Pump.

(1) Remove the fan from the water pump pulley.

(2) Remove the attaching bolts and lift the water pump assembly (21, fig. 42) from the block. Remove the gasket (22).

(3) Remove the bearing retainer wire (1, fig. 44). Press the bearing and shaft

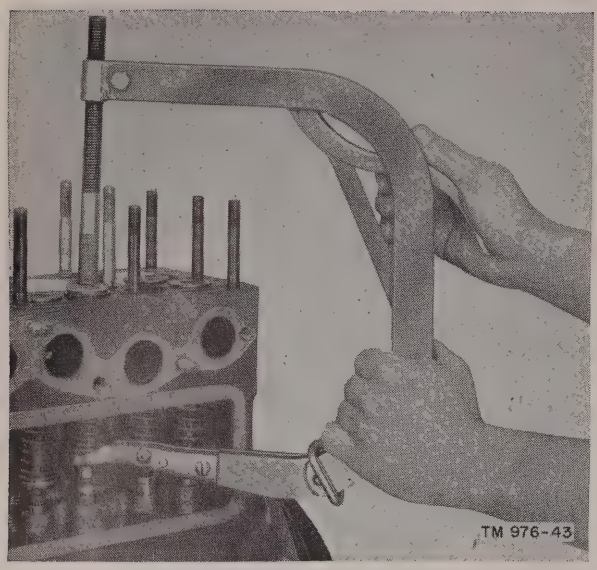


Figure 43. Removing valves.

(6) through the impeller (2) and the body (3). Remove the seal washer (4) and the seal (5). Then press the shaft from the pulley (7).

(4) Examine the seal washer seat in the pump body and reface if rough.

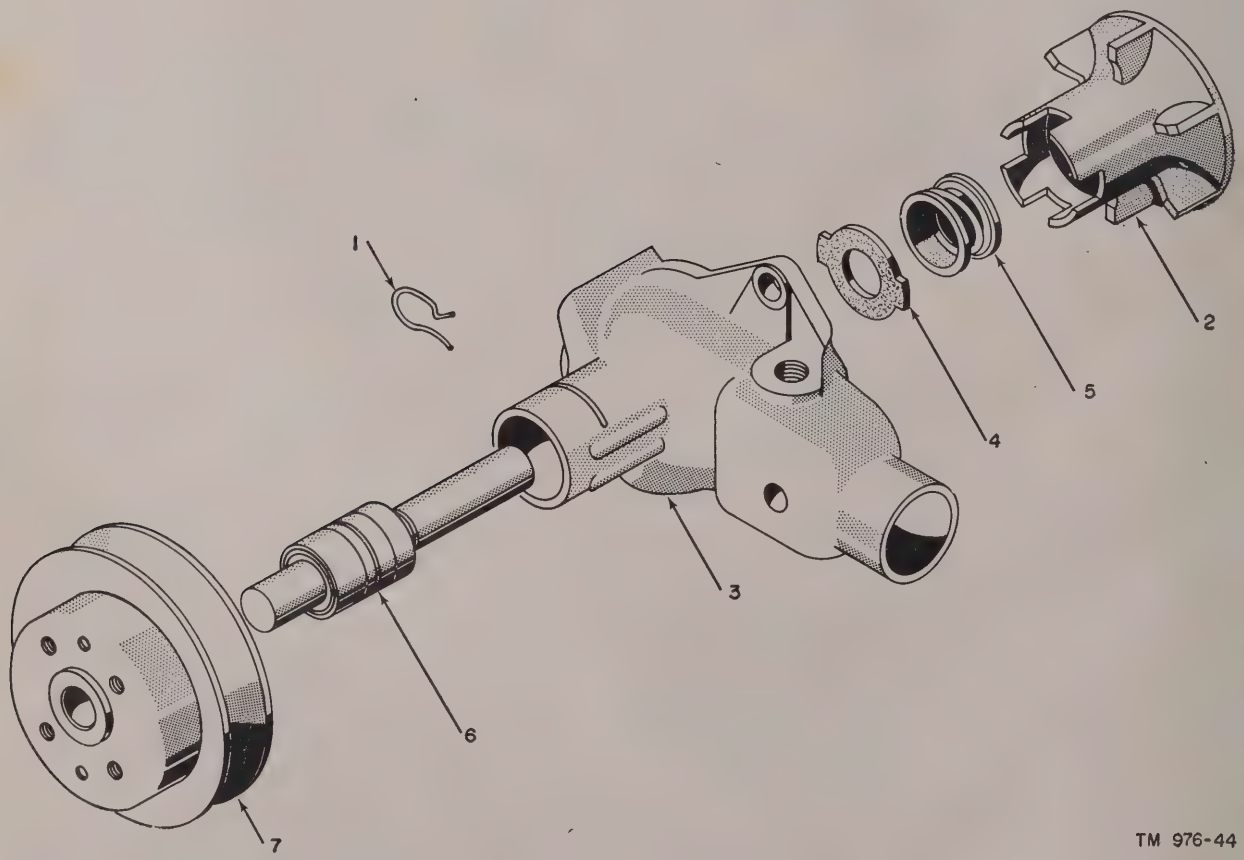
(5) Examine the seal for brittleness and cracks.

(6) Examine the bearing for binding and the shaft for scuff marks and scratches.

e. Oil Pan (fig. 42).

(1) Remove the oil pan (23) by removing the bolts and lock washers. Remove the oil pan gasket (24).

(2) Remove the cotter pin that is used to secure the oil float (25) to the oil



1 Bearing retaining wire (H123)
2 Impeller (A 13)
3 Pump body (A 14)
4 Seal washer (H120)
5 Seal (H121)
6 Bearing and shaft (O 55)
7 Fan and water pump pulley (O 54)

Figure 44. Water pump, exploded view.

float support (26). Remove the oil float support by removing the bolts and lock washers. Remove the gasket (27).

(3) Clean the oil pan with fuel oil (D–40 or D–35) and examine it for dents and cracks. Scrape gasket particles from the flange surface.

(4) Wash the float, screen, and support tube with fuel oil (D–40 or D–35) and remove any accumulation of dirt. Be sure the float support flange is flat and clean. Discard the oil float support gasket.

f. Oil Pump.

(1) Remove the oil pump (28, fig. 42) from the engine by removing the three mounting bolts. Remove the gasket (29).

Note. To remove the oil pump with the igniter assembly in the block, remove the igniter cover and cap and note the position of the rotor in order to reinstall the pump without disturbing the ignition timing.

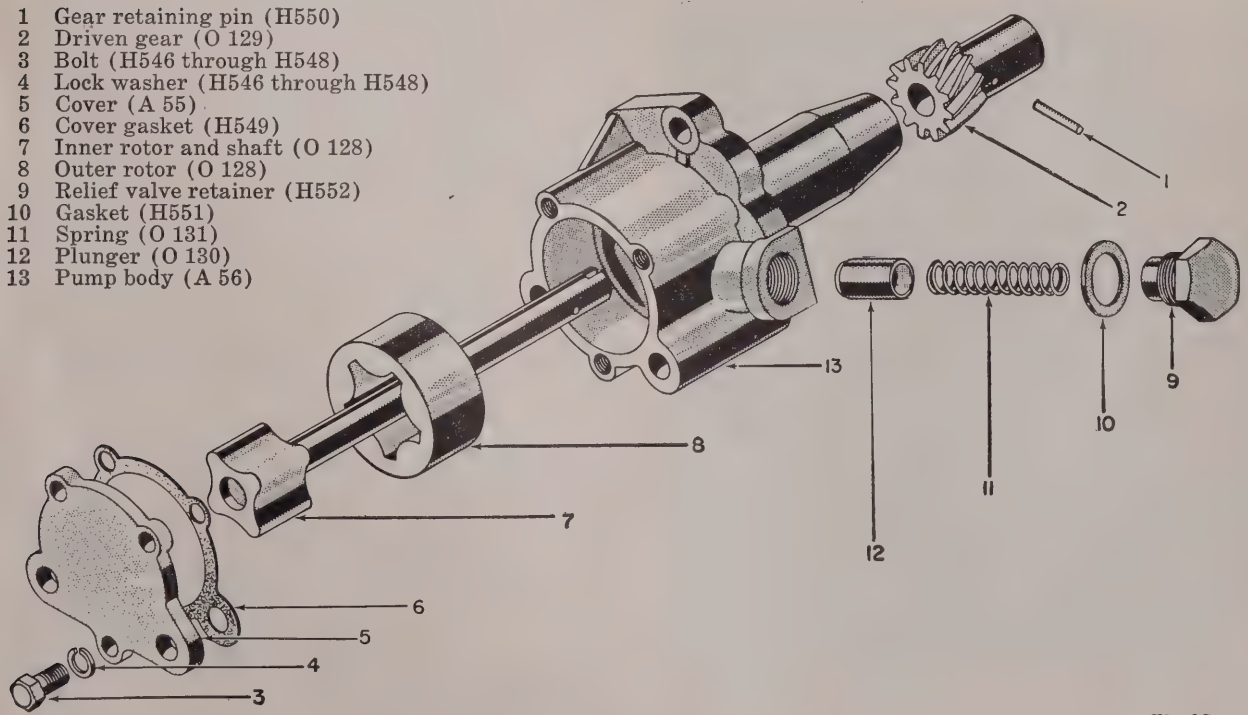
(2) Remove the gear (2, fig. 45) by filing off one end of the pin (1). Then drive the pin out with a small punch. Remove the bolts (3), the cover (5), and the gasket (6). The outer rotor (8) and inner rotor and shaft (7) now can be removed through the cover opening.

(3) Match the rotors together with one lobe of the inner rotor pushed completely into the notch of the outer rotor. Measure the clearance between the lobes as shown in figure 46. If this clearance is more than .010 inch, replace both rotors.

(4) Measure the clearance between the outer rotor and the pump body as shown in figure 47. If the clearance exceeds .012 inch, the pump body is faulty and should be replaced.

(5) Examine the inner surface of the cover for scoring or scratches. Check the flatness of the cover as shown in figure 48. It must be flat within .001 inch. The thickness of the rotors must be within .001 inch of each other. Assemble the rotors in the pump body and install the cover without the gasket. Tighten the cover screws to normal tension. Now it should be impossible to turn the pump shaft by

1 Gear retaining pin (H550)
2 Driven gear (O 129)
3 Bolt (H546 through H548)
4 Lock washer (H546 through H548)
5 Cover (A 55)
6 Cover gasket (H549)
7 Inner rotor and shaft (O 128)
8 Outer rotor (O 128)
9 Relief valve retainer (H552)
10 Gasket (H551)
11 Spring (O 131)
12 Plunger (O 130)
13 Pump body (A 56)



TM 976-45

Figure 45. Oil pump, exploded view.

hand. Remove the cover and replace it with the gasket in position. Now the rotors should turn with ease, proving that the end float of the rotors is less than the gasket thickness, or .004 inch.

g. Connecting Rods and Pistons (fig. 42).

(1) Remove the cylinder head as instructed in *b* above.

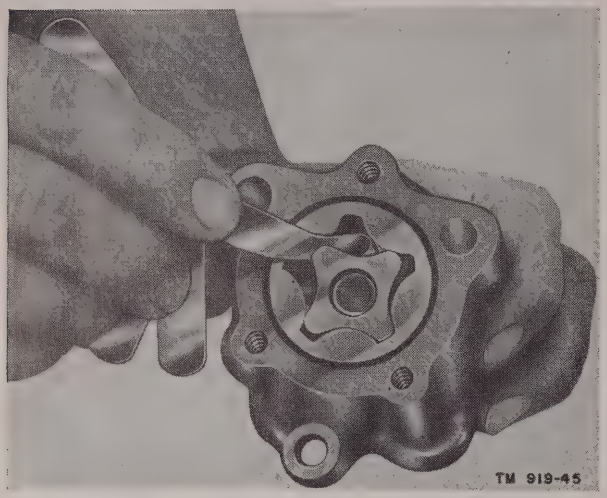


Figure 46. Checking oil pump rotors.

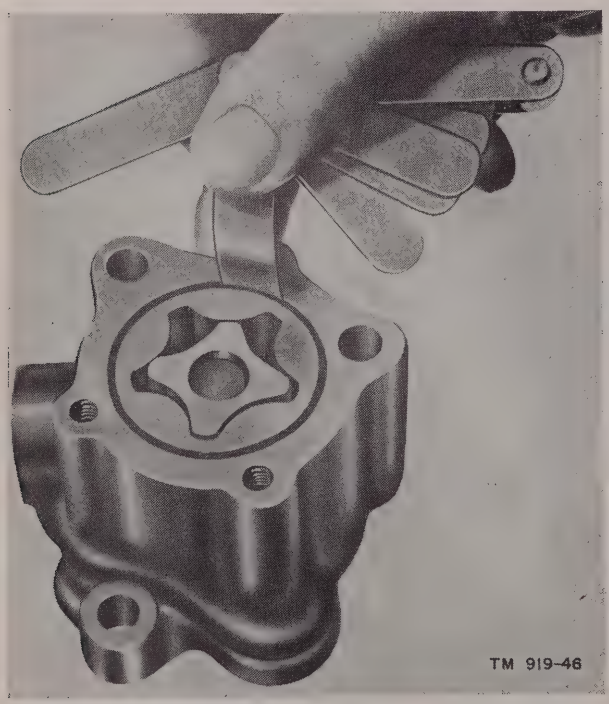


Figure 47. Checking clearance between outer rotor and oil pump body.

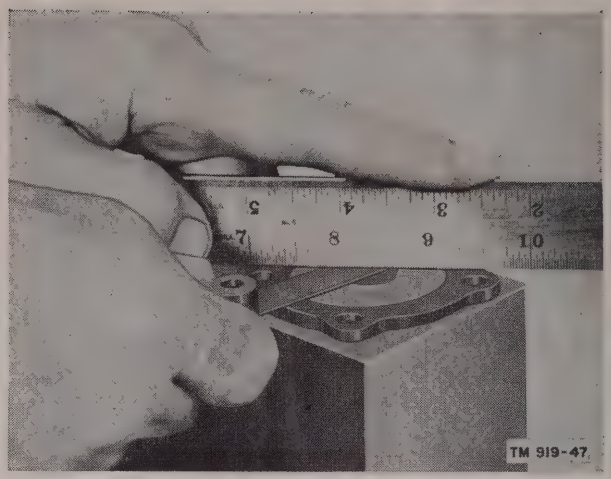


Figure 48. Checking oil pump cover.

(2) Remove the oil pan as instructed in *e* above.

(3) Turn the crankshaft until the lower end of the desired connecting rod is accessible.

(4) Remove the locknuts and nuts from the connecting-rod cap (30). Loosen the cap from the rod by tapping the cap with a soft hammer. Then remove the cap and lower bearing (31).

(5) Push the rod away from the crankshaft journal and remove the upper bearing (32).

(6) Use a ridge reamer to remove the carbon deposit from around the top of the cylinder bore. Keep the piston tops covered with cloth to prevent cuttings from falling into the engine.

(7) Wrap the lower end of the rod in cloth to prevent scratching the cylinder wall as the rod is being removed.

(8) Push the connecting rod and piston (33) out through the top of the cylinder bore.

(9) Repeat the procedures given in (1) through (8) above for all the connecting rods and pistons.

Caution: Connecting rods and caps are matched and must be paired together to insure correct reinstallation. Caps and rods are marked with their respective cylinder numbers.

(10) Remove the piston rings with a conventional ring remover.

(11) Remove the piston from the connecting rod by first removing the lockscrew. Then tap the piston pin from the piston and connecting rod.

(12) Check the connecting-rod bearing clearance and side clearance as instructed in paragraph 59*g*(6).

(13) Check the connecting rod on an alining fixture (fig. 49).

(14) Examine the bearing for chipping, scoring, and cracking. Examine the back of the bearings for bright spots, which indicate a loose fit in the caps.

(15) Clean the bearings and caps with fuel oil (D–40 or D–35) or cleaning solvent.

(16) Measure the clearance between the piston and cylinder wall as follows: Insert an inverted piston into the cylinder. Then measure the clearance with a .003-inch, ¾-inch wide feeler gage (fig. 50). This should give a 5-pound to 10-pound pull when being removed. The gage should extend the full length of the piston on the thrust side, opposite the slot.

(17) Scrape the carbon from the ring groove and soak the pistons in cleaning solvent. After soaking, clean the grooves again to be sure all carbon has been removed.

Note. A groove is located between the top of the piston and the top ring groove. This groove retards the flow of heat and should not be cleaned of carbon deposits because the accumulated carbon acts as an insulator.

h. Main Bearings (fig. 42).

(1) Remove the oil pan as instructed in *e* above.

(2) Remove the cap screws and lockwashers that are used to secure the main-bearing cap (34) to the block. Remove the bearing cap. Then remove the lower bearing (35) from the cap. Repeat the above procedures for the other two main bearings.

(3) Remove the upper main bearings as instructed in *m* below.

(4) Clean the main bearings and the caps with fuel oil (D–40 or D–35) or cleaning solvent.

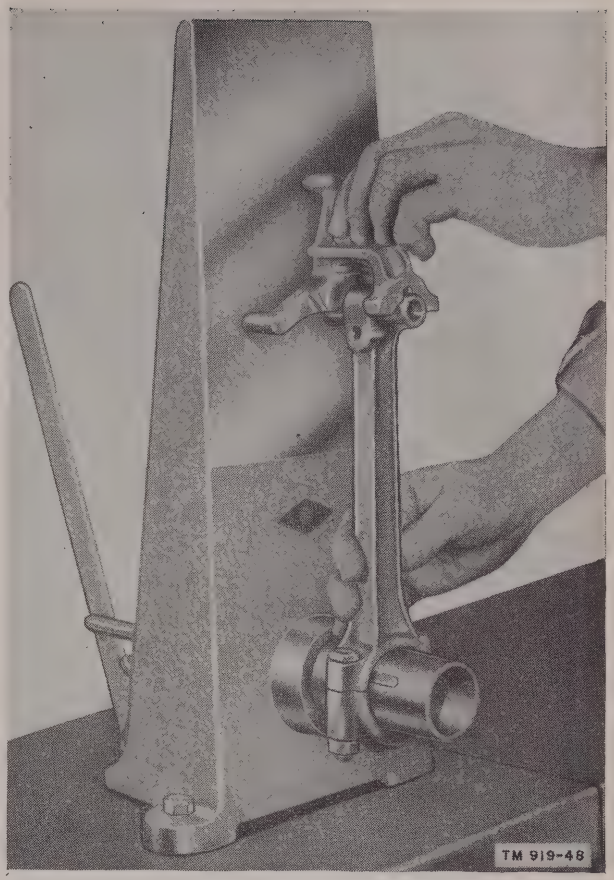


Figure 49. Alining connecting rod.

Figure 50. Checking piston clearance.

(5) Examine the bearings for chipping, scoring, and cracking. Examine the back of the bearings for bright spots, which indicate a loose fit in the caps.

(6) Check the bearing clearance as instructed in paragraph 59*a*(6).

i. Flywheel (fig. 42).

(1) Remove the nuts and lock washers that are used to secure the flywheel (43) to the crankshaft. Remove the flywheel.

(2) Examine the flywheel for nicks or burrs that may prevent even seating on the crankshaft flange. Examine the ring gear (44) for chipped or worn teeth.

(3) To remove the ring gear from the flywheel, heat the gear and tap it off with a hammer.

j. Flywheel Housing (fig. 42). Because the flywheel housing (45) must be alined perfectly when installed, do not remove it unless it is damaged enough to require replacement. If removal is necessary, remove the bolts and lockwashers that are used to secure the flywheel housing to the block and remove the housing.

k. Gear Cover (fig. 42).

(1) Remove the crank ratchet (47) from the crankshaft. Remove the crankshaft pulley (48) with a puller as shown in figure 51. Remove the key (60).

(2) Remove the nuts, bolts, and lock washers that are used to secure the gear cover (49) to the engine. Remove the gasket (50). Then pull the oil seal (51) out of the gear cover.

(3) Slip the oil slinger (61) and the crankshaft gear spacer (62) off the crankshaft (67).

(4) Wash all parts in fuel (D–40 or D–35) or cleaning solvent.

(5) Examine the gear cover for cracks.

(6) Examine the oil seal for evidence of leakage, nicks, and burrs.

l. Camshaft (fig. 42).

(1) Remove the manifolds as instructed in *a* above.

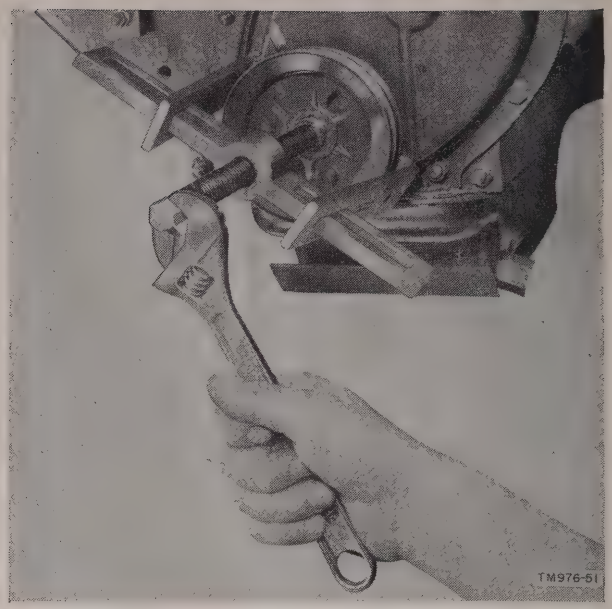


Figure 51. Removing crankshaft pulley.

(2) Remove the cylinder head as instructed in *b* above.

(3) Remove the valve mechanism as instructed in *c* above.

(4) Remove the oil pan as instructed in *e* above.

(5) Remove the oil pump as instructed in *f* above.

(6) Remove the gear cover as instructed in *k* above.

(7) Remove the bolt, lock washer, and gear washer that are used to secure the camshaft gear (54) to the camshaft (58). Then pull the camshaft gear from the camshaft with a puller. Remove the key (55).

(8) Remove the thrust plate (56) and slip the thrust plate spacer (57) off the camshaft.

(9) Tie the valve tappets (20) up at their highest point of travel with strings tied around the adjusting screws (19) and the manifold studs.

(10) Pull the camshaft forward, out of the block. Then remove the tappets.

(11) Clean the camshaft and the tappets with fuel oil (D–40 or D–35) or cleaning solvent.

(12) Carefully examine the camshaft for scores and roughness on the cam and

bearing surfaces. Check the oil pump drive gear for chipped or worn teeth. Measure the camshaft bearing clearance with a feeler gage. Standard bearing clearance is .001 inch to .0025 inch. If the bearing (59) is worn, drive it out with a drift.

(13) Examine the tappet faces and replace any that are scored, rough, or cracked. Standard clearance of the tappets in the guides is .0005 inch to .002 inch. Check and replace those that are worn excessively.

(14) Examine the camshaft thrust plate for rough edges, nicks, and burrs.

(15) Examine the camshaft gear for chipped and worn teeth.

m. Crankshaft (fig. 42).

(1) Remove the oil pan as instructed in *e* above.

(2) Remove the connecting-rod caps as instructed in *g* above.

(3) Remove the lower main bearings as instructed in *h* above.

(4) Remove the flywheel as instructed in *i* above.

(5) Remove the gear cover as instructed in *k* above.

(6) Then lift the crankshaft (67) out of the block.

(7) Remove the upper main bearings (36, 39, and 42). Clean and inspect the bearings as instructed in *h* above.

(8) Remove the crankshaft gear (63) with a puller. Remove the key (64). Slip the thrust washer (65) and shim (66) off the crankshaft.

(9) If it is necessary to install new bearings, use a micrometer to determine if the crankshaft journals are out-of-round. If the journals are out-of-round, in excess of the standard connecting rod or main-bearing clearance, regrind the shaft and install undersize bearings.

(10) Clean the crankshaft with fuel oil (D–40 or D–35) or cleaning solvent. Use a rifle brush and clean the oil passages in the shaft and the crankcase. Blow out with compressed air.

(11) Examine the crankshaft journals for cracks and score marks.

(12) Examine the crankshaft for misalinement.

(13) Examine the crankshaft gear for chipped or worn teeth.

n. Cylinder Block.

(1) Clean sludge out of the block with fuel oil (D–40 or D–35) or cleaning solvent.

(2) Remove the pipe plug and clean out the oil passage in the block with a rifle brush.

(3) Scrape carbon off the top of the block.

(4) Examine the block for cracks.

(5) Check the cylinder bores with a dial gage. If the cylinders are more than .005 inch out-of-the true, rebore them within .002 inch of the size desired. Finish and polish cylinders with a cylinder hone.

Section III. REASSEMBLY

Note. This section provides complete instructions necessary to reassemble Power Unit PU–26A/U. Instructions are included for reassembly of the engine and generator; details are also given for installation of those subassemblies removed in paragraph 53. The unit can be wired completely by referring to the appropriate wiring diagrams.

59. Reassembly of Engine

a. Crankshaft and Main Bearings (fig. 42).

(1) Slip the shim (66) and the thrust washer (65) onto the crankshaft (67). Be sure the side of the thrust washer with the inner beveled edge faces the front bearing. Insert the key (64) in the crankshaft groove and press the gear (63) onto the shaft.

(2) Place the upper main bearings (36, 39, 42) over the dowels in the block. If necessary, install new packing in the block. Follow the same procedure when installing this packing as when

installing packing in the rear main-bearing cap (subpar. (5) below).

(3) Apply clean oil (OE) to the main-bearing crankshaft journals. Then install the crankshaft in the block.

(4) Install the lower main bearings (35, 38, 41) on the crankshaft.

(5) Install new packing in the rear main-bearing cap as follows: Insert the packing in the groove of the cap. Roll the packing into the groove with a round piece of wood or steel (fig. 52). Start at one end and roll the packing to the center of the groove. Then start from the other end and again roll towards the center. Be sure the packing is pressed firmly into the bottom of the groove. The small portion of packing which protrudes above the surface of the cap at each end must be cut off flush.

(6) Check the clearance between the bearing and crankshaft journal as follows: Place a .002-inch shim between the journal and the bearing. Tighten the cap screws to the recommended torque of 65 to 70 pounds. A slight drag of the shaft, when turned by hand, proves the clearance (.002 in. to .0025 in.) is correct. Be sure to remove the shim.

(7) Reinstall the bearings and caps. Place liquid gasket sealer on the sides and face of the rear main-bearing cap.

(8) Check the end play of the crankshaft with a feeler gage (fig. 53). Clearance should be between .004 inch and .006 inch. To adjust the end play, remove the crankshaft gear and thrust washer and insert shims as required between the thrust washer and the face of the front main bearing.

(9) Insert rubber packings in the block as shown in figure 54. The packings will protrude approximately one-fourth inch from the block. When the oil pan is installed, it will force the packing tightly into the holes.

(10) When installing a new crankshaft or flywheel, replace the tapered dowel bolts with straight bolts furnished with these parts. Assemble the crankshaft and flywheel in proper relationship. Then install the straight bolts and tighten them securely. Next use a $^{35}/_{64}$-inch drill to enlarge the tapered holes. Ream the holes with a $^{9}/_{16}$-inch straight reamer and install the two special flywheel bolts instead of the tapered dowel bolts formerly used.

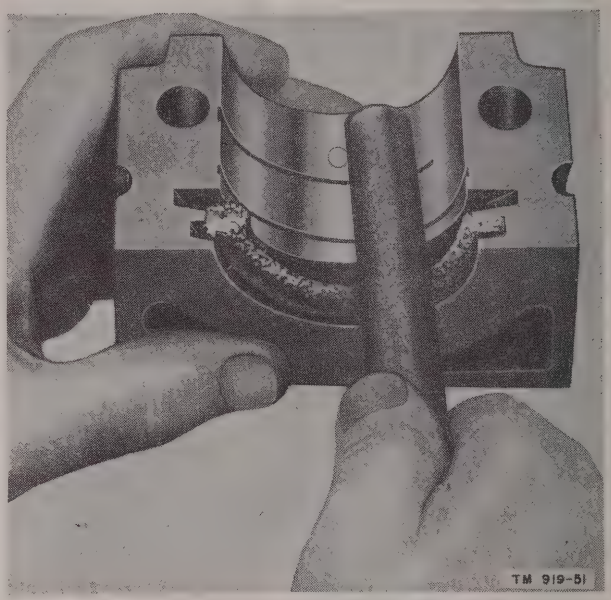


Figure 52. Installing rear main-bearing packing.

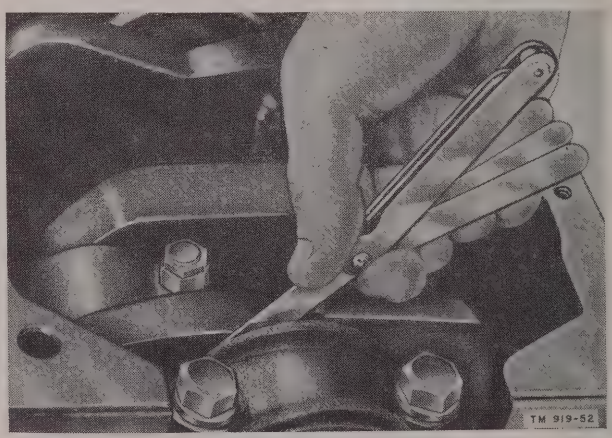


Figure 53. Checking crankshaft end play.

b. Flywheel (fig. 42).

(1) Heat the ring gear (44) and install it on the flywheel (43) by tapping it lightly. Be sure the gear is seated properly.

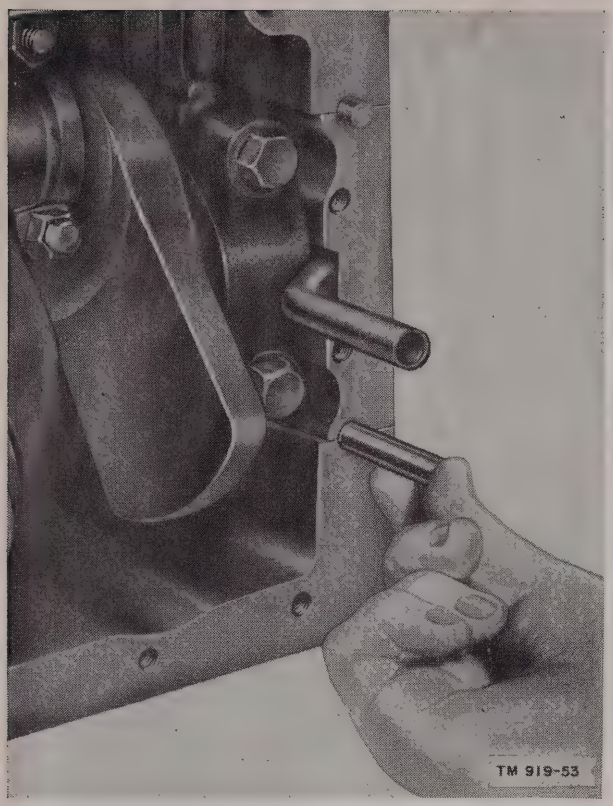


Figure 54. Installing rear main-bearing cap packing.

(2) Install the rear engine plate (46) to the block.

(3) Turn the crankshaft until the arrow stamped on the flywheel and the arrow stamped on the crankshaft flange are alined. This correctly locates the TC timing mark in relation to the No. 1 crank throw.

(4) Install the flywheel on the crankshaft and progressively tighten the attaching nuts with a torque wrench to a tension of 36 to 40 pounds.

Note. If a new flywheel is being installed, refer to *a*(10) above and proceed as instructed.

(5) After installation, check the runout of the flywheel with a dial indicator. It should not exceed .008 inch on the outer edge of the flywheel rear face.

c. Flywheel Housing (fig. 42).

(1) Secure the flywheel housing (45) to the block.

(2) Loosen the bolts and check the concentricity of the flywheel housing bore with the flywheel as follows: Position a dial indicator on the flywheel as shown in figure 55. Turn the crankshaft slowly and observe the reading on the indicator. Shift the flywheel housing until centered within a tolerance of .003 inch. Then tighten the bolts. Recheck the concentricity after tightening.

(3) Check the face of the flywheel housing with a dial indicator as shown in figure 56. The housing should be parallel to the flywheel face within .003 inch. If the housing is not parallel, place shims between the engine block and the flywheel housing. Then recheck until the desired reading is reached. Be sure to tighten the bolts before each recheck.

Caution: It is essential that the above steps be taken when installing the flywheel housing to insure proper generator air gap. Also, if the tolerances are greater than those specified, the resultant strain may cause serious damage to the bearing and rotor.

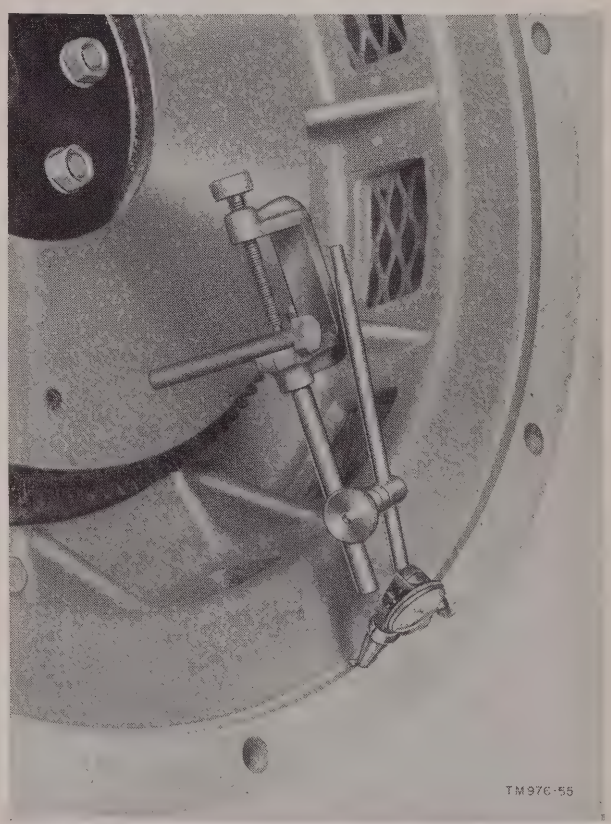


Figure 55. Checking concentricity of flywheel housing with flywheel.

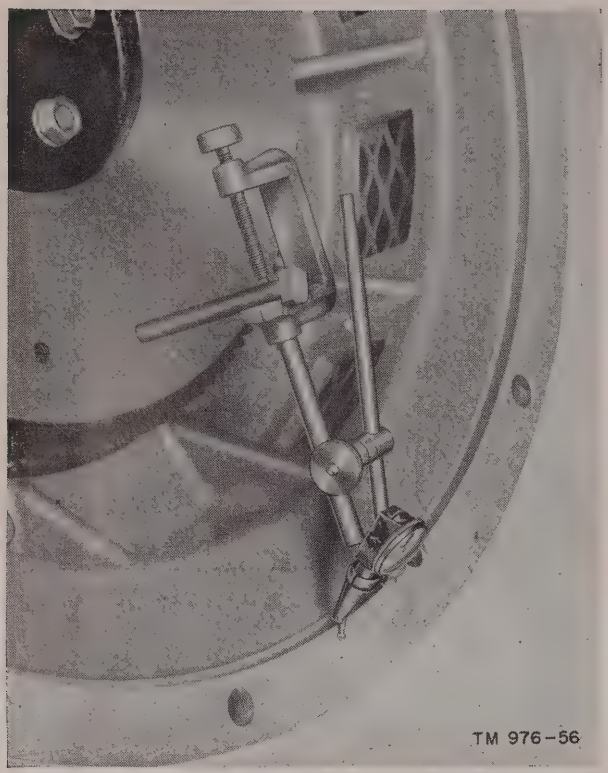


Figure 56. Checking face of flywheel housing with flywheel.

d. Camshaft (fig. 42).

(1) Press the camshaft bearing (59) into the block and stake it in place as shown in figure 57.

(2) Install the valve tappets (20) and tie them with string attached to the manifold studs. Check the tappet clearance in the guides as instructed in paragraph 58*l*(13).

(3) Install the camshaft (58) in the block and check the bearing clearance as instructed in paragraph 58*l*(12). Then slip the thrust plate spacer (57) on the camshaft with the beveled inner edge toward the rear and secure the shaft with the thrust plate (56), lock washers, and bolts.

(4) Position the key (55) in the camshaft keyway. Install the gear (54) with the camshaft and crankshaft positioned so that the timing gear marks are in alinement as shown in figure 58. Secure the gear washer and lock washer and the bolt securing the gear to the camshaft.

(5) Check the end play of the camshaft with a feeler gage inserted between the camshaft gear and the thrust plate. The clearance should be .003 inch to .0055 inch. Reduce the clearance by placing a thin shim between the thrust plate spacer and the camshaft shoulder. Increase the clearance by dressing-off the spacer lightly.

(6) Check the backlash between the timing gears with a dial indicator. The tolerance should not be more than .002 inch.

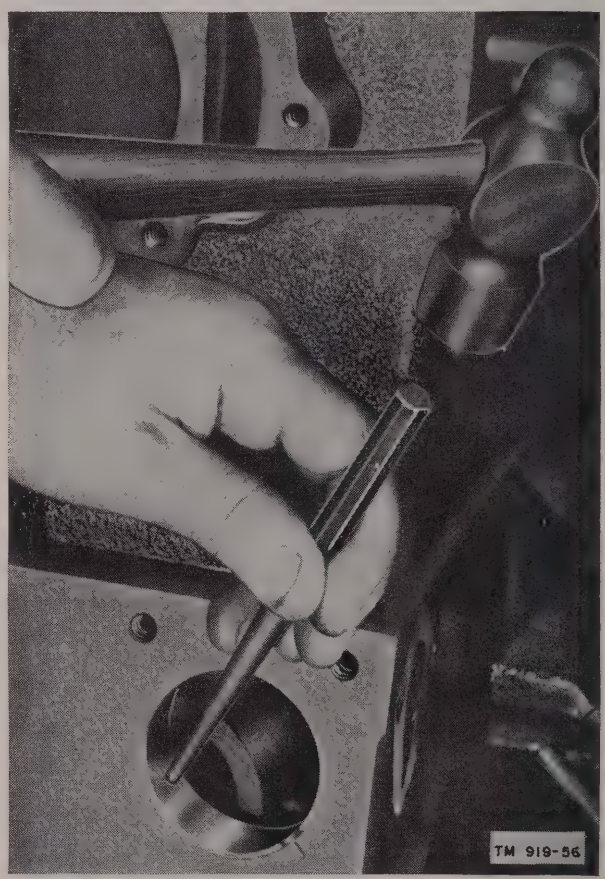


Figure 57. Staking camshaft bearing.

e. Valve Mechanism (fig. 42).

(1) Replace the valve guides (18) by using a valve guide driver. Position the exhaust valve guide 1 inch and the intake valve guide $1\frac{5}{16}$ inch below the top face of the cylinder block (fig. 59).

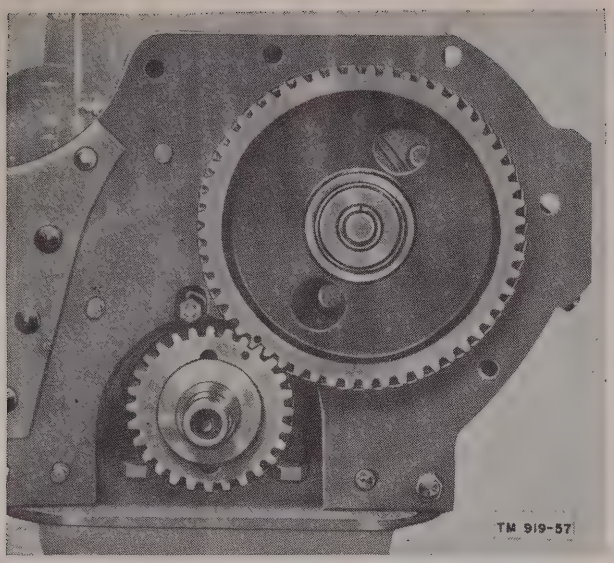


Figure 58. Timing gears, punch marks alined.

(2) Assemble the valve springs (16) and rotocaps (17) in the engine with the closed coils of the springs placed against the cylinder block.

(3) Install the valves (15) in the same positions from which they were removed.

(4) Compress the springs on the valves which are in closed position. Insert the valve locks (14) in the valve-stem groove. Turn the crankshaft until the open valves become closed and install the remaining valve locks.

(5) Adjust the valve tappets as instructed in paragraph 62*c*.

(6) Remove the cloth from the valve compartment floor openings. Then cement a new gasket (13) in position on the valve cover plate (12). Install the cover. Be sure the copper ring gaskets are under the attaching cover plate screws.

f. Gear Cover (fig. 42).

(1) Slip the crankshaft gear spacer (62) and the oil slinger (61) onto the crankshaft.

(2) Tap the oil seal (51) into the gear cover (49) with a small block of wood.

(3) Coat the gear cover gasket (50) with gasket cement and position the gasket on the gear cover.

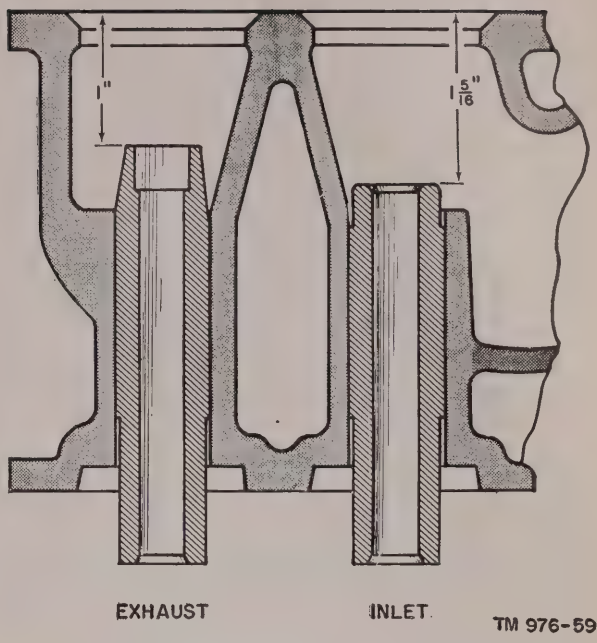


Figure 59. Position of valve guides.

(4) Secure the cover and gasket to the block with the bolts, lock washers, and nuts.

(5) Insert the key (60) in the crankshaft keyway and press the pulley (48) onto the shaft. Then secure the crank ratchet (47) to the shaft.

g. Connecting Rods and Pistons (fig. 42).

(1) Check the piston clearance as instructed in paragraph 58*g*(16).

(2) Check the piston ring gap as follows: Push the ring into the cylinder with a piston. Check the end gap with a feeler gage as shown in figure 60. The end gap should be .008 inch to .013 inch. Check each piston ring individually.

(3) Check the piston ring groove clearance. Groove clearance of the upper compression ring should be .002 inch to .004 inch; that of the lower compression ring should be .0015 inch to .0035 inch. Clearance of the oil regulating ring should be .001 inch to .0025 inch.

(4) Clamp the connecting rod in a vise; use vise jaw shields of soft metal or hardwood. Start the piston pin into the piston with the lockscrew groove

facing downward. Assemble the piston to the connecting rod with the slot in the piston on the opposite side from the oil spray hole in the bearing end of the rod. Install the piston pin lockscrew and lock washer. Check the alinement of the connecting rod as instructed in paragraph 58*g*(13).

(5) Use a conventional ring tool and install the rings on the pistons as follows: Position the upper compression ring with the inside beveled edge toward the top (fig. 61). The face of the lower compression ring is tapered .001 inch and the letters T or T-O-P on the upper edge (fig. 61) indicate how the ring should be installed. Install the rings with the ring gaps staggered around the piston.

(6) Apply oil (OE) to the piston. Install a ring compressor over the rings on the piston. Then force the connecting rod and piston (33) down through the cylinder bore by tapping the top of the piston with a hammer handle. Install the connecting-rod bearings (31 and 32). Aline the oil spray holes in the upper bearing with the spray holes in the connecting rods. The spray holes should be facing away from the camshaft. Because of the offset on the rods, the No. 1 rod cannot be interchanged with the No. 2 rod and the No. 3 rod cannot be interchanged with the No. 4 rod. The clearance between the bearings and the crankshaft journal should be checked with a .002-inch test shim. Place the shim between the bearing and the shaft journal; tighten the cap nuts to a tension of 35 to 40 pounds. A slight drag on the shaft, when turned by hand, indicates that the clearance is correct. Remove the shim and reinstall the cap. The standard side clearance of the bearing is .005 inch to .009 inch, which should be measured with a feeler gage (fig. 62).

(7) The spring locknuts should be renewed. Install them with the flat face toward the connecting-rod nut. Turn the locknuts fingertight. Then tighten with a wrench one-half turn.

Figure 60. Measuring piston ring gap.

h. Oil Pump.

(1) Assemble the outer rotor (8, fig. 45) and the inner rotor and shaft (7) in the oil pump body (13).

(2) Position the gasket (6) and the cover (5) on the pump body and secure them with the bolts (3) and lock washers (4).

(3) Secure the gear (2) to the pump shaft with the retaining pin (1). Check the

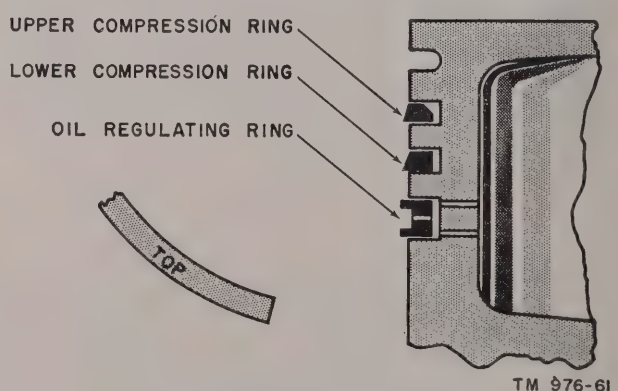


Figure 61. Piston ring installation.

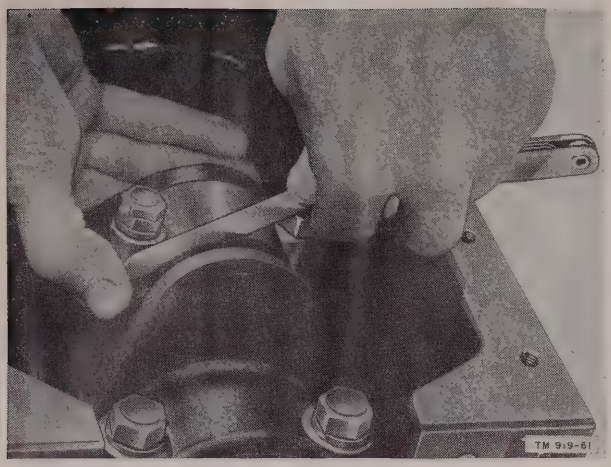


Figure 62. Checking connecting rod end play.

clearance between the gear and pump body with a feeler gage. This clearance should be from .003 inch to .010 inch.

(4) Insert the plunger (12) and spring (11) in the pump body and secure them with a relief valve retainer (9) and gasket (10).

(5) Install the igniter assembly as instructed in paragraph 61*i*.

(6) Position the gasket (29, fig. 42) on the pump body and secure the oil pump (28) to the engine with the mounting bolts.

Note. Always install the oil pump after the igniter assembly has been installed (par. 61*i*).

i. Oil Pan (fig. 42).

(1) Position a new gasket (27) on the oil float support flange and secure the float support (26) to the engine with the bolts and lock washers.

(2) Secure the oil float (25) to the float support with a cotter pin.

(3) Install the oil pan (23) temporarily and check to see that the front main counterweight does not hit the front end of the oil pan. Should there be interference, bend the pan forward to obtain clearance.

(4) Position the oil pan gasket (24) on the oil pan. Secure the pan to the engine with the bolts and lock washers. Tighten the bolts to a tension of 10 to 14 pounds.

j. Cylinder Head (fig. 42).

(1) Position the cylinder-head gasket (11) on the block without using sealer or other compound.

(2) Place the cylinder head (10) on the block and install the cylinder-head nuts fingertight. Then tighten the nuts with a torque wrench to a tension of 60 to 65 pounds in accordance with the sequence shown in figure 63. Tighten the nuts gradually two or three times to reach the recommended torque value.

(3) Adjust the spark plugs by setting the electrode gap at .030 inch. Install the spark plugs to prevent any foreign matter entering the combustion chambers during the remaining operations.

(4) Install the thermostat (9), thermostat adapter (8), and thermostat retainer (7) in the coolant outlet elbow (5).

(5) Position the outlet elbow gasket (6) and secure the coolant outlet elbow on the cylinder head.

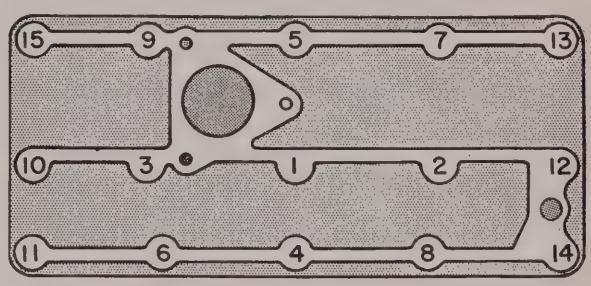


Figure 63. Cylinder-head nut tightening sequence.

k. Water Pump.

(1) Install the long end of the shaft (6, fig. 44) in the pump body (3) from the front end until the outer end of the bearing is flush with the front end of the pump body.

(2) Dip the seal (5) and the seal washer (4) in hydraulic brake fluid and position them on the shaft.

(3) Place the impeller (2) on an arbor press and install the long end of the

shaft into the impeller until the end of the shaft is flush with the hub of the impeller.

(4) Support the assembly on the impeller end of the shaft and install the fan pulley (7). To insure correct belt and fan alinement, the distance between the machined face (rear) of the pump body and the fan mounting face of the pulley *must* be $4^{23}/_{32}$ inches.

(5) Move the shaft in the pump body to aline the retaining wire groove and place the retaining wire (1) in position.

(6) Position the gasket (22, fig. 42) and secure the water pump (21) to the engine with the bolts and lock washers.

(7) Install the bypass line to the cylinder head.

l. Manifolds (fig. 42).

(1) Position a new gasket (4) over the manifold studs on the block.

(2) Secure the exhaust manifold (3) to the block with the nuts and washers.

(3) Position a new gasket (2) on the exhaust manifold. Then place the intake manifold (1) in position and install the bolts and lock washers that are used to secure the manifolds together. Secure the intake manifold to the block with the nuts and washers. Then tighten all manifold nuts to a tension of 31 to 35 pounds.

m. Installation of Engine.

(1) Secure a hoist to the engine lifting eye and position the engine in the lower frame. Rest the rear of the engine on a block of wood placed under the oil pan and secure the front of the engine to the front mounts with the mounting bolts.

(2) Secure the two ground straps on the front engine mounts to the engine.

(3) Reinstall the generator as instructed in paragraph 60. Reinstall the subassemblies and accessories in accordance with pertinent instructions in paragraph 61.

60. Reassembly of Generator

(fig. 37)

a. Reassembly of Rotor.

(1) Position the blower assembly (49) to the rotor drive hub. Make sure the two marks, made before disassembly, are alined. Replace the screws (47), lock washers (48) and the lockwire.

(2) Place a canvas belt around the motor assembly (42). Attach a hoist to the belt and swing the rotor into position against the engine flywheel. Mount the rotor assembly to the flywheel with the screws (43) and lock washers (44). Secure the screws with lockwire. Remove the chain hoist and the canvas belt. Replace the air scroll (39) and secure it with the lock washers (40) and screws (41).

(3) Press the bearing (45) into the liner (46). Then press the bearing and the liner onto the rotor shaft.

b. Reassembly of Exciter Field Ring, Stator, and Stator Housing.

(1) Heat the outside of the stator housing (15) uniformly with a heating torch. Aline the two bars on the stator (35) with the top center rib of the stator housing. Guide the stator cables through the bushing openings and at the same time slide the stator assembly into place against the rear of the housing.

(2) Heat the stator housing around the exciter field ring opening. Aline the lower center dowel pin of the exciter field ring (24) with the slot in the stator housing (15). Press the exciter ring in until the outer raised edge of the ring rests firmly against the stator housing.

Caution: Do not allow the temperature of the stator housing to rise above 180° F.

(3) Replace the junction box cover plates (38) and secure them with the screws (36) and lock washers (37).

(4) Hook a chain hoist into the lifting eye on the stator housing. Carefully swing the housing and stator assembly over

the rotor. Secure the stator housing to the flywheel housing (34) with the bolts (33), washers (31, 32), lock washers (30), and nuts (29). Raise the generator and the rear of the engine slightly and remove the blocks from under the oil pan. Lower the engine until the stator housing ears rest on the shock mounts and lower frame. Secure the stator housing to the frame with the bolts (28), washers (27), lock washers (26), and nuts (25). Remove the chain hoist and the generator lifting eye.

c. Reassembly of End Bell Assembly.

(1) Replace the four capacitors (23) in the end bell (2) and secure them with the screws (21) and the lock washers (22). Replace the brush holder assembly (4) with the nuts (18), lock washers (19), and washers (20). The brush holder assembly must be mounted in neutral position. One edge of the brush holder is marked with a spot of paint and the end bell is marked with a similar spot. These two markings must be kept in perfect alinement at all times to prevent excessive arcing of the brushes on the commutator segments.

(2) Mount the bearing cover plate (11) on the end bell and secure it with the screws (16) and lock washers (17). Use two long bolts and aline the inner row of the bearing cover plate with the holes of the bearing liner (46). Heat the end bell around the bearing opening and push the end bell forward to rest in place over the bearing (45) and against the stator housing. Secure the end bell with the screws (12), lock washers (13), and flat washers (14). Remove the two long alining bolts and replace the screws (9) and the washers (10) in the bearing cover plate.

(3) Connect the exciter field leads as shown in figure 64. Replace the brushes (7, 8) in the brush holders. Install the brush spring assemblies (5, 6). Recheck the brush springs to see that they are installed correctly; it is possible to replace them upside-down in the holders.

(4) Replace the brush cover band (1) and secure it to the end bell (2) with the two mounting bolts, washers, and nuts.

(5) Tighten the two lower radiator mounting bolts. Secure the muffler mounting clamp to the lower frame support.

61. Installation of Subassemblies and Accessories

a. Fuel Pump.

(1) Position the fuel pump gasket on the fuel pump flange.

(2) Install the fuel pump on the engine and secure it with the two bolts and lock washers.

(3) Connect the fuel lines from the carburetor and the filter to the fuel pump.

b. Engine Speed Governor.

(1) Position the governor on the engine and secure it with the three bolts, lock washers, and flat washers. Do not tighten the bolts.

(2) Install the governor drive belt.

(3) Adjust the drive belt for about 1-inch deflection and tighten the governor mounting bolts.

(4) Connect the oil line from the governor to the valve cover plate.

(5) Connect the carburetor-to-governor linkage to the governor control arm and the carburetor throttle.

c. Carburetor and Overspeed Safety Governor.

(1) Position the lead gasket, the heat shield, another lead gasket, and the overspeed safety governor on the intake manifold in that order.

(2) Place the composition gasket and carburetor on the governor.

(3) Secure the carburetor and governor to the intake manifold with two nuts and lock washers.

(4) Connect the fuel line from the fuel pump to the carburetor.

(5) Position the air horn on the carburetor and secure it with the clamp.

(6) Connect the carburetor-to-governor linkage to the engine-speed governor control arm and the carburetor throttle.

(7) Connect the manual throttle cable to the carburetor throttle control.

(8) Connect the automatic choke rod to the carburetor.

d. Fuel Filter.

(1) Secure the fuel filter to the mounting bracket with the two bolts, nuts, lock washers, and flat washers.

(2) Connect the fuel line from the filter to the fuel pump and the fuel line from the fuel inlet connection to the fuel filter.

(3) Be sure the drain cock is closed.

e. Oil Pressure Cutoff Switch and Oil Pressure Transmitter.

(1) Screw the switch into the bottom of the tee fitting and the transmitter into the top.

(2) Connect the electrical leads as shown in figure 64.

f. Muffler.

(1) Place the muffler assembly in position on the unit.

(2) Secure the muffler with the clamp located on the front engine support.

(3) Position a new gasket between the exhaust pipe adapter and the exhaust manifold. Then secure the muffler assembly to the manifold with one bolt and two nuts.

(4) Secure the automatic choke in position on the adapter and attach the choke rod to the carburetor.

g. Oil Filter.

(1) Secure the oil filter to the bracket on the engine with the two bolts, nuts, lock washers, and flat washers.

(2) Connect the oil lines from the timing gear cover, engine speed governor, and engine block to the oil filter.

h. High-Coolant-Temperature Cutoff Switch.

(1) Screw the cutoff switch into the coolant outlet elbow with the dial facing the left of the unit.

(2) Connect the electrical lead as shown in figure 64.

i. Igniter Assembly.

(1) Remove the No. 1 spark plug. Rotate the crankshaft until the No. 1 piston is coming up on the compression stroke and until the 5° mark on the flywheel is in the center of the timing hole as shown in figure 65.

(2) Install the igniter assembly in the cylinder block. (Always install the oil pump after the igniter assembly has been installed.) Use the rotor on the distributor shaft to turn the shaft until the rotor points toward the No. 1 spark plug terminal tower position with the contact points just breaking.

(3) Correctly mesh the oil pump gear with the driving gear on the camshaft to allow engagement of the offset drive tongue on the distributor shaft with the pump shaft driving slot. Assembly can be made in only one position as the slot and drive tongue are machined off-center. Always check the position of the rotor and contact points ((3) above) after this operation.

(4) Install the spark plugs. Connect the ignition cables. Place them in the cap terminal towers in the firing order sequence of 1–3–4–2.

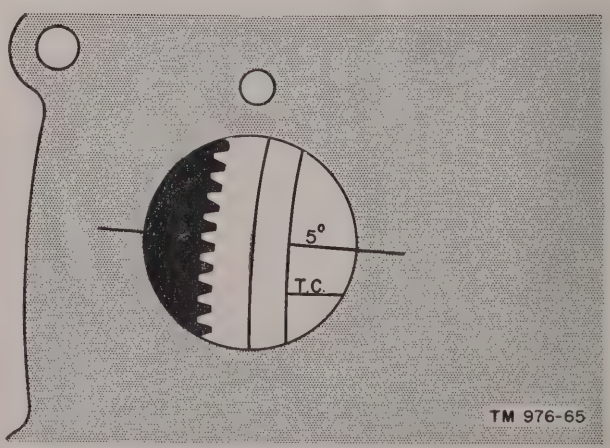
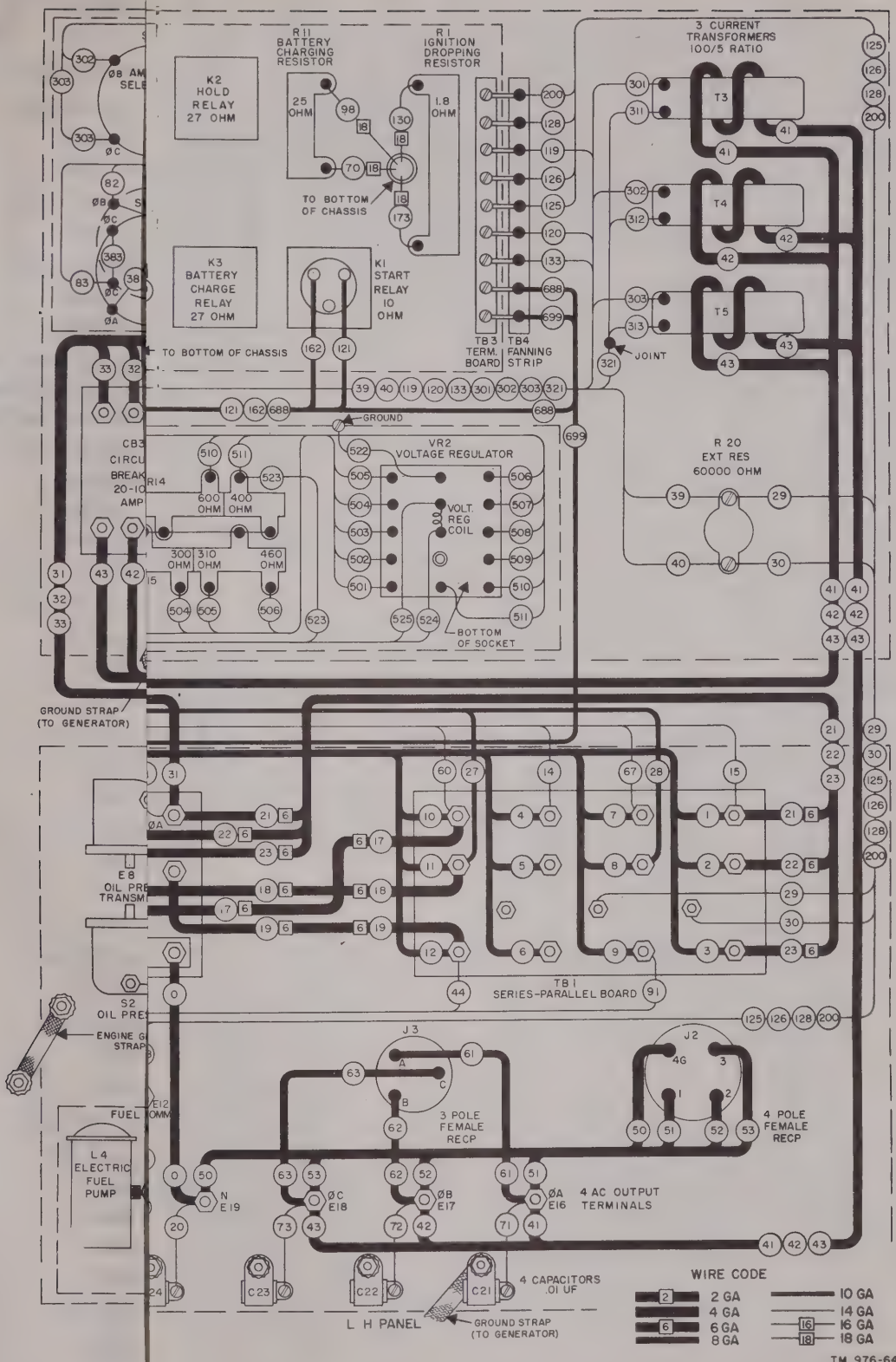


Figure 65. Flywheel timing marks.


R11 BATTERY CHARGING RESISTOR
R1 IGNITION DROPPING RESISTOR
3 CURRENT TRANSFORMERS 100/5 RATIO
K2 HOLD RELAY 27 OHM
25 OHM
1.8 OHM
TO BOTTOM OF CHASSIS
K3 BATTERY CHARGE RELAY 27 OHM
K1 START RELAY 10 OHM
TB3 TERM. BOARD
TB4 FANNING STRIP
JOINT
TO BOTTOM OF CHASSIS
GROUND
VR2 VOLTAGE REGULATOR
VOLT. REG COIL
BOTTOM OF SOCKET
R 20 EXT RES 60000 OHM
CB3 CIRCU BREAK 20-10 AMP
R14
600 OHM
400 OHM
300 OHM
310 OHM
460 OHM
R15
GROUND STRAP (TO GENERATOR)
E8 OIL PR TRANSM
S2 OIL PRE
ENGINE G STRAP
TB1 SERIES-PARALLEL BOARD
J3
3 POLE FEMALE RECP
J2
4 POLE FEMALE RECP
FUEL
L4 ELECTRIC FUEL PUMP
N E19
ØC E18
ØB E17
ØA E16
4 AC OUTPUT TERMINALS
C23
C22
C21
4 CAPACITORS .01 UF
L H PANEL
GROUND STRAP (TO GENERATOR)
WIRE CODE
2 GA
4 GA
6 GA
8 GA
10 GA
14 GA
16 GA
18 GA

TM 976-64

(4) Connect the fuel line from the fuel pump to the carburetor.

(5) Position the air horn on the carburetor and secure it with the clamp.

(6) Connect the carburetor-to-governor linkage to the engine-speed governor control arm and the carburetor throttle.

(7) Connect the manual throttle cable to the carburetor throttle control.

(8) Connect the automatic choke rod to the carburetor.

d. Fuel Filter.

(1) Secure the fuel filter to the mounting bracket with the two bolts, nuts, lock washers, and flat washers.

(2) Connect the fuel line from the filter to the fuel pump and the fuel line from the fuel inlet connection to the fuel filter.

(3) Be sure the drain cock is closed.

e. Oil Pressure Cutoff Switch and Oil Pressure Transmitter.

(1) Screw the switch into the bottom of the tee fitting and the transmitter into the top.

(2) Connect the electrical leads as shown in figure 64.

f. Muffler.

(1) Place the muffler assembly in position on the unit.

(2) Secure the muffler with the clamp located on the front engine support.

(3) Position a new gasket between the exhaust pipe adapter and the exhaust manifold. Then secure the muffler assembly to the manifold with one bolt and two nuts.

(4) Secure the automatic choke in position on the adapter and attach the choke rod to the carburetor.

g. Oil Filter.

(1) Secure the oil filter to the bracket on the engine with the two bolts, nuts, lock washers, and flat washers.

(2) Connect the oil lines from the timing gear cover, engine speed governor, and engine block to the oil filter.

h. High-Coolant-Temperature Cutoff Switch.

(1) Screw the cutoff switch into the coolant outlet elbow with the dial facing the left of the unit.

(2) Connect the electrical lead as shown in figure 64.

i. Igniter Assembly.

(1) Remove the No. 1 spark plug. Rotate the crankshaft until the No. 1 piston is coming up on the compression stroke and until the 5° mark on the flywheel is in the center of the timing hole as shown in figure 65.

(2) Install the igniter assembly in the cylinder block. (Always install the oil pump after the igniter assembly has been installed.) Use the rotor on the distributor shaft to turn the shaft until the rotor points toward the No. 1 spark plug terminal tower position with the contact points just breaking.

(3) Correctly mesh the oil pump gear with the driving gear on the camshaft to allow engagement of the offset drive tongue on the distributor shaft with the pump shaft driving slot. Assembly can be made in only one position as the slot and drive tongue are machined off-center. Always check the position of the rotor and contact points ((3) above) after this operation.

(4) Install the spark plugs. Connect the ignition cables. Place them in the cap terminal towers in the firing order sequence of 1–3–4–2.

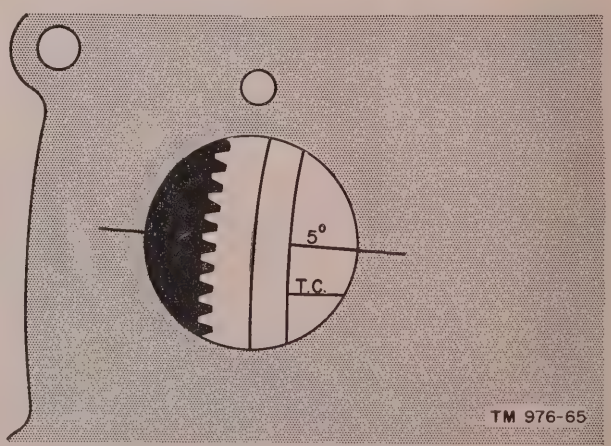


Figure 65. Flywheel timing marks.

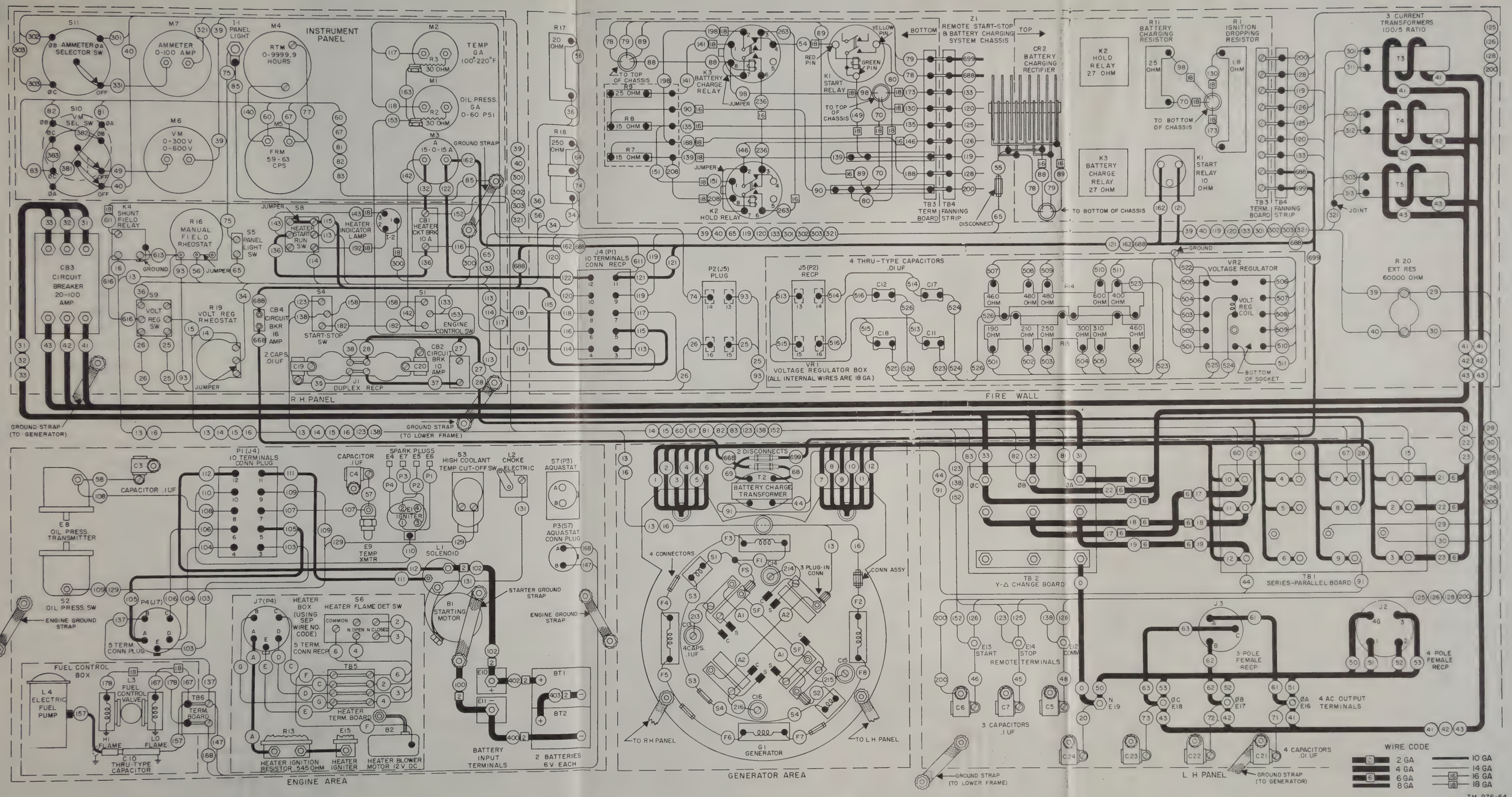


Figure 64. Pictorial wiring diagram.

(5) Connect the air hoses from the air cleaner and ventilating control valve to the igniter assembly.

j. Starting Motor.

(1) Secure the starting motor to the flywheel housing with the two bolts and lock washers.

(2) Connect the starting motor ground strap to the engine block.

(3) Connect the electrical leads to the solenoid switch and starting motor as shown in figure 64.

k. Winterization System. To install the component parts of the winterization system, follow the applicable instructions below:

(1) *Heater exchanger pan.* Position the exchanger on the engine oil pan and secure it with the two bolts, nuts, and lock washers. Connect the outlet tube to the heat exchanger pan.

(2) *Heater.*

(*a*) Secure the heater to the mounting bracket by using the two bottom bolts and lock washers only.

(*b*) Connect the coolant hoses to the engine and the heater and tighten the hose clamps.

(*c*) Install the heat exchanger tube to the combustion outlet on the top of the heater and to the heat exchanger. Tighten the clamps.

(*d*) Plug the socket containing the electrical leads into the heater.

(*e*) Position the heat shield and secure it with the top heater mounting bolts and lock washers.

(3) *Fuel pump and fuel control valve.*

(*a*) Secure the fuel pump in the heater control box with the two bolts, nuts, and lock washers. Mount the control valve with the four bolts and lock washers.

(*b*) Connect the fuel line from the fuel filter to the fuel pump, the line from the pump to the control valve, and the line from the valve to the heater.

(*c*) Connect the electrical leads as shown in figure 64.

l. Radiator.

(1) Secure the fan to the water pump pulley with the four bolts and lock washers.

(2) Position the radiator on the lower frame and secure it to the bottom radiator support with the two nuts and lock washers.

(3) Install the coolant hoses to the radiator, water pump, and engine. Tighten the radiator hose clamps.

(4) Secure the fan guard to the radiator.

m. Upper Frame.

(1) Position the upper frame on the lower frame and secure it at the four corners with the bolts, nuts, and lock washers.

(2) Connect the four ground straps to the right and left sides of the upper frame.

(3) Connect the manual CHOKE to the carburetor.

(4) Secure the radiator to the upper frame with the two bolts, nuts, and lock washers.

(5) Connect all the electrical leads as shown in figure 64.

(6) Plug the 10-conductor socket into the receptacle mounted on the fire wall.

(7) Replace the clip, located on the fire wall, which is used to secure the cable for the manual THROTTLE and the tube for the PRIMING PUMP.

(8) Reconnect the capacitor to the oil-pressure transmitter.

n. Air Cleaner.

(1) Secure the air cleaner to the mounting brackets on the upper frame with the four bolts, nuts, and lock washers.

(2) Connect the air line from the air cleaner to the igniter assembly and the breather line from the air cleaner to the oil-filler tube.

(3) Install the inlet and outlet air-duct hose from the air cleaner to the carburetor and air collector.

62. Adjustments Prior to Final Testing

Previous to final testing of the unit after overhaul, certain adjustments must be made to insure efficient operation of the unit. Make these adjustments as instructed below:

a. Ignition Timing. If the ignition has not been timed, refer to paragraph 61*i* and proceed as instructed.

b. Valve Timing. With the camshaft gear and crankshaft gear positioned as instructed in paragraph 59*d*(4), check the timing as follows: Carefully adjust the inlet valve tappet for No. 1 cylinder to .020 inch. Rotate the crankshaft clockwise until the piston in the No. 1 cylinder is ready for the intake stroke. The intake opens 9° before top dead center as shown in figure 66. Note the distance between the top center mark and the 5° mark and estimate the 9° position. With the crankshaft in this position, timing is correct if the tappet is just tight against the valve stem. Readjust the tappet to the running clearance of .016 inch.

c. Valve Tappets. Check the valve tappet clearance with a feeler gage as shown in figure 67. Both the intake and exhaust tappet clearance must be .016 inch with the engine cold.

d. Engine Speed Governor. Refer to paragraph 25*b* and adjust the engine-speed governor as instructed.

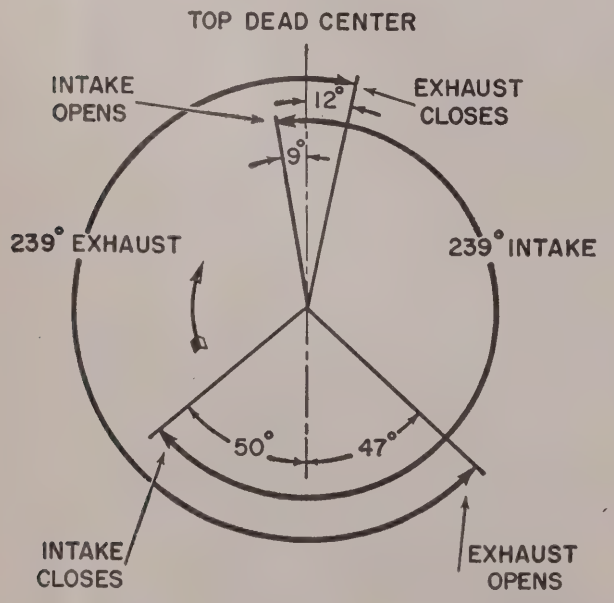


Figure 66. Valve timing.

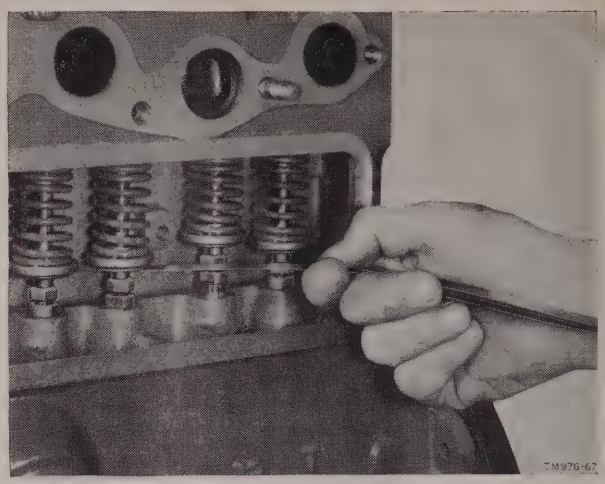


Figure 67. Checking valve tappet clearance.

e. Engine Overspeed Safety Governor. To adjust the overspeed safety governor, turn the adjusting screw clockwise until it stops. With the unit operating at 25 percent overspeed (2,250 rpm), turn the adjusting screw counterclockwise until the engine just starts to slow down. Then back the adjusting screw clockwise two turns and seal the adjustment.

f. Carburetor.

(1) *Idle adjustment.* When adjusting the idle jet (always with the engine hot) it should be set on the rich side of the highest vacuum. Attach a vacuum gage to the manifold and screw the idle adjusting screw in or out until the highest point of vacuum is reached, then continue backing out the screw until the vacuum starts to recede from the highest point.

(2) *Altitude adjustment.* With the unit operating at rated full load, the altitude adjustment setting must be checked with an exhaust gas analyzer. Screw the adjusting screw in or out until the analyzer indicates a 13.4 to 1 air-fuel ratio at full load or a 12.6 to 1 ratio at no load.

Note. It may be necessary to readjust the idle adjusting screw (*f*(1) above) in order to obtain this air-fuel ratio range.

g. Choke Valve Adjustment. Adjustment of the choke will be required whenever its operation is not satisfactory, whenever the choke or carburetor has been removed and replaced, and

when switching from normal to low-temperature operation and vice versa. When choke adjustment is required, proceed as follows:

(1) Temperature down to —35° F.

(*a*) Remove the carburetor air cleaner fitting from the carburetor air horn.

(*b*) Loosen the butterfly valve (choke) arm clamp screw. Close the butterfly valve by hand and set the butterfly control arm in an exact horizontal position, pointing toward the generator end of the unit. Retighten the clamp screw.

(*c*) Loosen the control arm clamp bolt on the automatic choke so that the arm is free to rotate.

(*d*) Insert a short piece of $\frac{3}{32}$-inch (.093 in.) diameter wire into the index hole in the rear end of the automatic choke shaft to prevent the choke shaft from turning.

(*e*) Close the butterfly valve by hand and, while holding the butterfly valve in closed position, retighten the automatic choke control arm bolt.

(*f*) Remove the piece of $\frac{3}{32}$-inch wire and then reassemble the air cleaner fitting to the carburetor air horn.

(2) Temperatures from 0° to —65° F.

(*a*) Follow instructions in *g*(1)(*a*) through (*d*) above.

(*b*) Insert a piece of $\frac{1}{4}$-inch diameter (.250 in.) rod in the carburetor air horn. The rod must not come into contact with the internal filet in air horn. Hold the piece of $\frac{1}{4}$-inch rod in position in the air horn and close the butterfly valve against it by hand. While holding the butterfly valve against the $\frac{1}{4}$-inch rod, retighten the automatic choke control arm clamp bolt.

(*c*) Remove the piece of $\frac{3}{32}$-inch wire and the $\frac{1}{4}$-inch rod and reassemble the air cleaner fitting to the carburetor air horn.

h. Winterization System.

(1) *Fuel control valve.* Disconnect the fuel line at the heater and place a glass container graduated in cubic centimeters under the line. Start the heater and, with a stopwatch, time the flow of fuel. Fill the glass container for approximately 2 or 3 minutes and measure the average fuel flow for 1 minute. Fuel flow should average 7 cubic centimeters per minute with the heater operating on *low fire* and between 15 and 17 cubic centimeters per minute with the heater operating on *high fire.* The adjustment screw, located on the dome in the center of the valve, controls the flow of fuel for both high and low fire. It is, therefore, necessary to find the best medium for both high and low rating.

(2) *Flame switch.* To adjust the flame switch, back the flame switch adjusting screw *out* until a click is heard, then turn the adjusting screw *in* until a click is heard again. Turn the screw three-fourths of a turn beyond this point.

i. Voltage Regulator. If a new regulator has been put into service, first check all circuit connections. If necessary adjust the variable resistor as instructed in paragraph 25*b*(4). If hunting occurs, adjust the voltage regulator dash pot (par. 25*b* (4)).

63. Testing and Inspection After Overhaul

a. Before starting the unit, refer to paragraph 21 and complete the preliminary procedure as instructed.

b. Start the unit as instructed in paragraph 22.

c. Certain precautions must be taken after the unit is in operation. Refer to paragraph 23 and follow the applicable instructions.

d. Apply load to the unit as instructed in paragraph 24. Apply only a 25 percent load during the first hour of operation. For each 1-hour period thereafter, increase the load in 25-percent steps until the unit is operating under full load. Check the performance at each load change with the characteristics given in paragraph 6.

e. During the operation of the unit, follow the procedure outlined in paragraph 25.

64. Painting and Weatherproofing

a. When painted portions of the equipment become scratched or chipped, refinish the damaged surfaces as instructed in paragraph 39.

b. If the windings in the stator, rotor, battery-charging transformer, and current transformers have been slightly scuffed, apply a coat of fungiproof varnish in accordance with specification JAN–T–152 and with TB SIG 13. Always apply fungiproof varnish to newly soldered connections and to any bare copper wire which has been installed. No other parts of the equipment need to be treated.

65. Radio-frequency Suppression Equipment

Power Unit PU–26A/U is equipped to suppress r-f interference with nearby radio and radar equipment. The unit is suppressed with shielding, bonding straps, capacitors, resistor-suppressors, and bonds made by external-internal-toothed lock washers. Examine the suppression equipment periodically, in accordance with instructions in paragraph 46. Whenever the unit has been overhauled, make sure that all suppression components have been reinstalled correctly. The suppression equipment is designed to suppress r-f interference only when the unit is in satisfactory condition. If the unit is operating abnormally, for example, excessive sparking of commutator brushes, shorted armature, etc., the suppression equipment may not control the radio frequencies produced. It is, therefore, essential that the unit be checked thoroughly before assuming that the fault lies with the suppression equipment. All suppression equipment is described and located in the subparagraphs below and illustrated in figure 68.

a. Igniter Assembly. The distributor and coil are housed within a metal shielded inclosure. Four resistors (5,000 ohms each) are incorporated integrally within the distributor at the four castles. A feedthrough capacitor (2.0 μf) is installed in the primary terminal of the assembly. The entire assembly is bonded to the adjusting plate with one ¼-inch external-internal-toothed lock washer. The adjusting plate is bonded to the engine block with one ¼-inch external-internal-toothed lock washer.

b. Spark Plugs. The spark plugs are integrally shielded and suppressed (10,000 ohms ea.). The high tension cables are shielded with a special conducting material.

c. Output Terminals. Four CA–472 capacitors (.01 μf ea.) are secured to the output terminals and are bonded to the frame, utilizing two ¼-inch external-internal-toothed lock washers for each capacitor.

d. Remote Control Terminals. Three CA–442 capacitors (.1 μf ea.) are secured to the remote control terminals and are bonded to the frame, utilizing two ¼-inch external-internal-toothed lock washers each.

e. Convenience Outlet Receptacle. Two CA–472 capacitors (.01 μf ea.) are secured to the outlet receptacle, utilizing three No. 8 external-internal-toothed lock washers each.

f. Heater Fuel Pump. The heater fuel pump contains a shielded lead and incorporates a feedthrough capacitor (.25 μf) sealed in the lead connectors. The fuel pump is bonded to the heater fuel control box, utilizing two ¼-inch external-internal-toothed lock washers. The lead mounting clip is bonded to the box with three No. 10 external-internal-toothed lock washers. Two ground clips are used to bond the box to the frame.

g. Heater. The heater is bonded to the heater mounting bracket, utilizing four ⅜-inch external-internal-toothed lock washers.

h. Remote Starting Control Chassis. The remote starting control chassis is bonded to the fire wall with four No. 10 external-internal-toothed lock washers.

i. Voltage Regulator Box. Four 79P11 capacitors (.01 μf ea.) are incorporated within the voltage regulator box. The box is bonded to the fire wall with four No. 10 external-internal-toothed lock washers.

j. Engine. The front of the engine block is bonded to the front engine mounts with two ground straps (left and right sides) utilizing two ⅜-inch external-internal-toothed lock washers and one ¼-inch ground clip each.

k. Oil Pressure Transmitter. The oil pressure transmitter is suppressed by means of a CA–442 capacitor (.1 μf) bonded to the fire wall with two ¼-inch external-internal-toothed lock washers.

l. Coolant Temperature Transmitter. The coolant temperature transmitter is suppressed by means of a CA–442 capacitor (.1 μf) bonded to the engine block, utilizing two ¼-inch external-internal-toothed lock washers.

m. Instrument Panel. The instrument panel is bonded to the control panel with one ground strap, utilizing four No. 10 external-internal-toothed lock washers.

n. Fire Wall. The fire wall is bonded to the frame with ten No. 10 and two ¼-inch external-internal-toothed lock washers.

o. Generator. The generator brush rigging is suppressed by means of four CA–482 capacitors (.1 μf ea.) bonded to the end bell, utilizing two ¼-inch external-internal-toothed lock washers each. The right side of the generator is bonded to the control panel with a ground strap utilizing one ¼-inch ground clip and two ⅜-inch external-internal-toothed lock washers. The left side of the generator is bonded to the frame with a ground strap, utilizing two ⅜-inch external-internal-toothed lock washers and three ¼-inch external-internal-toothed lock washers (secured with the PHASE-A output terminal capacitor).

p. Frame. The upper frame is bonded to the lower frame with two ground straps (left and right side), utilizing two ¼-inch ground clips each.

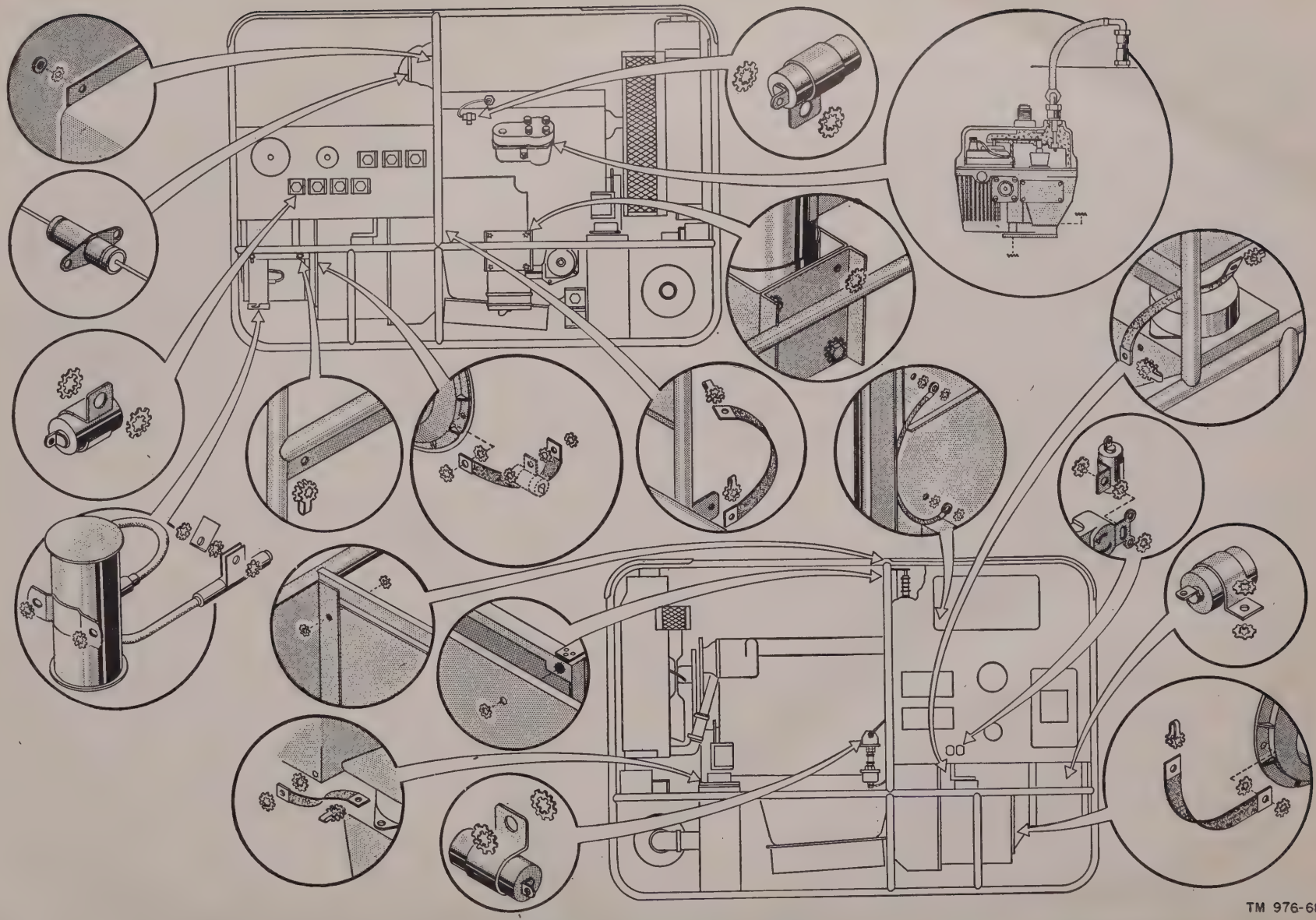


Figure 68. R-f suppression details.

OPERATOR FIRST ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT

POWER UNITS, REEL UNITS *(Engine-Driven)*
(SR 750-405-10)

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE	EQUIPMENT SERIAL NO.

LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; I Adjustment, repair or replacement required; Ⓧ Defect corrected
NOTE: Strike out items not applicable.

DAILY

NO.	ITEM	CONDITION S	M	T	W	T	F	S
1	BEFORE OPERATION INSPECT FOR TAMPERING AND/OR DAMAGE.							
2	INSPECT FOR COMPLETENESS AND GENERAL CONDITION. INCLUDE TOOLS AND ACCESSORIES. PARS. 11, 41 0 846							
3	FUEL AND LUBRICATING SYSTEMS - INSPECT FOR LEAKS. PARS. 21 846							
4	EXHAUST SYSTEM; GASKETED JOINTS - INSPECT FOR LEAKS. PAR. 46							
5	COOLING SYSTEM - INSPECT FOR LEAKS, CLEANLINESS, AND GENERAL CONDITION. PARS. 21 846							
6	CLEAN EXTERIOR OF EQUIPMENT.							
7	FUEL FILTER - CHECK SEDIMENT BOWL FOR FOREIGN MATTER. PAR. 46							
8	AIR CLEANER; BREATHER - INSPECT FOR GENERAL CONDITION AND CLEANLINESS. PAR. 46							
9	SPARK PLUGS *(small units only)* - REMOVE, INSPECT, AND CLEAN.							
10	LUBRICATION - LUBRICATE IN ACCORDANCE WITH LUBRICATION ORDER.							
11	FUEL; OIL; WATER - REPLENISH AS NEEDED. ADD ANTIFREEZE IN LOW TEMPERATURES. PARS. 21, 27 846							
12	DURING OPERATION PARS. 23 825 BE ALERT FOR UNUSUAL NOISE, VIBRATION, EXHAUST SMOKE, HEATING, MISFIRING, AND FAULTY OPERATION.							
13	AFTER OPERATION REPEAT BEFORE-OPERATION SERVICES. LEAVE EQUIPMENT READY TO OPERATE. PAR. 26							
14	RECORD DAILY HOURS OF OPERATION.							

WEEKLY

NO.	ITEM	CONDITION	NO.	ITEM	CONDITION
15	BATTERY - INSPECT CONNECTIONS, LOOK FOR CORRODED POSTS, CRACKED CASES. TEST ELECTROLYTE. ADD WATER. PARS. 21 846		23	MAIN GENERATOR - INSPECT COMMUTATOR, SLIP RINGS, AND BRUSHES. PAR. 46	
16	WIRING - INSPECT EXPOSED WIRING FOR CUTS, CRACKS, FRAYING, LOOSE TERMINALS, LOOSE OR DIRTY CONNECTIONS. PAR. 46		24	METERS; GAGES - INSPECT CONDITION, MOUNTING CONNECTIONS. CHECK FOR CORRECT INDICATION. PAR. 21	
17	AIR CLEANER - INSPECT FOR DIRT OBSTRUCTIONS. IN OIL-BATH TYPE, CHECK OIL LEVEL AND CONDITION. SERVICE BREATHER. PAR. 46		25	LUBRICATION - LUBRICATE IN ACCORDANCE WITH LUBE ORDER.	
18	FUEL TANK; CAP - INSPECT TANK FOR LEAKS, SECURITY. BLOW THROUGH CAP VENT. INSPECT CAP GASKET.		26	FINISH - INSPECT PAINTED SURFACES. REMOVE RUST. TOUCH UP PAINTED SURFACES. PAR. 39	
19	COUPLINGS; ALIGNMENT - CHECK COUPLINGS AND ALIGNMENT OF COMPONENTS. PAR. 46		27	FUEL; LUBRICANT; COOLANT - INSPECT FOR CONTAMINATION. REPLENISH. PAR. 46	
20	TIGHTEN ALL LOOSE NUTS, BOLTS, SCREWS, AND OTHER FASTENINGS.		28	TEST - OPERATE EQUIPMENT AND OBSERVE OPERATION OF AUTOMATIC CONTROLS, GOVERNOR, SWITCHES, GAGES.	
21	BELTS - INSPECT CONDITION, TENSION, ALIGNMENT. PAR. 46		29	ADJUST; REPAIR - MAKE ADJUSTMENTS AND REPAIRS AS AUTHORIZED.	
22	CARBURETOR - INSPECT MOUNTING AND LINKAGE. CHECK FOR LEAKS. CLEAN EXTERIOR. PAR. 46		30	RECORD TOTAL HOURS OPERATED DURING PERIOD COVERED BY THIS REPORT.	

31 IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION.

DA FORM 1 JAN 53 11-260 REPLACES DA AGO FORM 11-260, 1 MAY 51, WHICH MAY BE USED

TM 976-69

Figure 69. DA Form 11-260.

SECOND AND THIRD ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT

POWER UNITS, REEL UNITS *(Engine-Driven)*

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE	EQUIPMENT SERIAL NO.

LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustment, repair or replacement required; (X) Defect corrected.
NOTE: Strike out items not applicable.

NO.	ITEM	CONDITION
1	INSPECT FOR TAMPERING AND/OR DAMAGE.	
2	INSPECT FOR COMPLETENESS AND GENERAL CONDITION. INCLUDE TOOLS AND ACCESSORIES. PARS 11, 41 & 46	
3	COOLING; LUBRICATING; AND FUEL SYSTEMS - INSPECT FOR LEAKS. PARS. 21 & 46	
4	EXHAUST SYSTEM; GASKETED JOINTS - CHECK FOR LEAKS; GENERAL CONDITION PARS. 21 & 46	
5	COOLING SYSTEM - INSPECT GENERAL CONDITION. CLEAN. FLUSH LIQUID-COOLED SYSTEMS. PARS. 21 & 46	
6	CLEAN EXTERIOR OF EQUIPMENT.	
7	FUEL STRAINER - CLEAN SEDIMENT BOWL AND SCREEN. PAR. 46	
8	GOVERNOR; THROTTLE - INSPECT MOUNTING; CONTROL LINKAGE FOR FREE MOVEMENT, WEAR, AND LUBRICATION. PAR. 46	
9	FUEL TANK; CAP; GASKET - INSPECT TANK FOR LEAKS AND SECURITY; FILLER CAP CONDITION; GASKET CONDITION.	
10	AIR CLEANER - DISASSEMBLE AND CLEAN. SERVICE OIL-BATH TYPE IN ACCORDANCE WITH LUBE ORDER. PAR. 46	
11	CRANKCASE; OIL FILTER - SERVICE CRANKCASE AND OIL FILTER IN ACCORDANCE WITH LUBE ORDER. PAR. 46	
12	BATTERY - TEST ELECTROLYTE AND VOLTAGE. CHECK FOR LEAKS, CORRODED POSTS, LOOSE CONNECTIONS. INSPECT MOUNTING OR HANGER. PARS. 21 & 46	
13	WIRING - INSPECT EXPOSED WIRING FOR CUTS, FRAYING, CRACKS, AND LOOSE OR BROKEN CONNECTIONS. PAR. 46	
14	MAGNETO OR DISTRIBUTOR - CLEAN EXTERIOR. INSPECT, CLEAN OR REPLACE AND ADJUST BREAKER POINTS. PAR. 46	
15	SPARK PLUGS - REMOVE AND INSPECT FOR CRACKED, CHIPPED, OR BURNED INSULATORS, EXCESSIVE DEPOSITS AND BURNED ELECTRODES. PAR. 46	
16	SUPPRESSION - INSPECT SUPPRESSION COMPONENTS FOR CONDITION AND GOOD CONTACT. PAR. 65	
17	RELAYS; SWITCHES - INSPECT FOR CONTACT PITTING, ALIGNMENT, CORROSION, AND PRESENCE OF DIRT AND MOISTURE. SEE THAT MOUNTINGS AND CONNECTIONS ARE SECURE. PARS. 21 & 46	
18	STARTING MOTOR - INSPECT COMMUTATOR, BRUSHES, MOUNTING. TEST OPERATION. PAR. 46	
19	CHARGING GENERATOR - INSPECT COMMUTATOR, BRUSHES, MOUNTING. TEST OPERATION AND OUTPUT.	
20	BELTS - INSPECT FOR CONDITION, ADJUSTMENT, ALIGNMENT. CLEAN OFF OIL AND GREASE. PAR. 46	
21	FUEL PUMP - INSPECT MOUNTING. CHECK FOR LEAKS. TEST OPERATION. PAR. 46	
22	VALVES - INSPECT VALVE MECHANISM FOR BROKEN SPRINGS, STICKING, TAPPET, CLEARANCE. ADJUST TAPPETS. PAR. 46	
23	COMPRESSION - CRANK ENGINE BY HAND AND OBSERVE COMPRESSION. PAR. 46	
24	COUPLINGS AND ALIGNMENT - CHECK SECURITY AND ALIGNMENT OF COUPLINGS. CHECK ALIGNMENT OF DRIVING AND DRIVEN COMPONENTS. PAR. 46	
25	NUTS; BOLTS; SCREWS - TIGHTEN LOOSE NUTS, BOLTS, SCREWS AND OTHER FASTENINGS.	
26	MAIN GENERATOR; EXCITER - CHECK BRUSHES, COMMUTATOR, SLIP RINGS, BRUSH SPRINGS AND MOUNTINGS. PAR. 46	
27	METERS; GAGES - INSPECT FOR CONDITION, BENT INDICATOR, HANDS, BROKEN GLASS, LOOSE MOUNTING AND CONNECTIONS, CORRECT ZERO ADJUSTMENT. PAR. 21	
28	FUEL; OIL; COOLANT - REPLENISH. PARS. 21, 27 & 46	

OPERATION TEST

NO.	ITEM	CONDITION
29	STARTING - CRANK ENGINE AND OBSERVE OPERATION OF STARTING MECHANISM. NOTE ANY DIFFICULTY IN STARTING.	
30	OPERATION - OPERATE ENGINE AND NOTE ANY TENDENCY TO STALL OR MISFIRE. LISTEN FOR UNUSUAL NOISE. WATCH FOR OVERHEATED PARTS AND EXCESSIVE EXHAUST SMOKE.	
31	GOVERNOR ACTION - APPLY AND REMOVE LOAD AND OBSERVE ACTION OF GOVERNOR. ADJUST IF NECESSARY. PAR. 25	
32	CLUTCH - ENGAGE AND DISENGAGE. CHECK FOR INDICATIONS OF GRABBING OR SLIPPING.	
33	CONTROLS; SWITCHES - CHECK OPERATION. SEE THAT METERS AND GAGES INDICATE CORRECTLY. PARS. 21 & 46	
34	GENERATOR - REMOVE PROTECTIVE COVERS AND CHECK FOR SPARKING BRUSHES. INSPECT SLIP RINGS AND COMMUTATOR. CHECK FOR HIGH, LOW OR FLUCTUATING VOLTAGE. PAR. 46	
35	MODIFICATIONS - SEE THAT REQUIRED MODIFICATIONS HAVE BEEN COMPLETED. CORRECT DIAGRAMS.	
36	ADJUSTMENTS - MAKE NECESSARY ADJUSTMENTS TO EQUIPMENT.	
37	FINISH - REMOVE RUST AND CORROSION; TOUCH UP OR REFINISH PAINTED SURFACES. PAR. 39	
38	FUNGIPROOF - TREAT EQUIPMENT IN ACCORDANCE WITH CURRENT DIRECTIVES.	
39	TOOL BOX; TOOLS - CLEAN TOOLS AND TOOL BOX THOROUGHLY. SEE THAT TOOLS ARE STOWED PROPERLY.	
40	FUEL; OIL; COOLANT - REPLENISH FUEL, OIL, AND COOLANT. PROTECT LIQUID COOLING SYSTEMS WITH ANTIFREEZE, WHEN NECESSARY. PARS. 21, 27 & 46	

41 IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION.

DA FORM 1 JAN 53 11-261 REPLACES DA AGO FORM 11-261, 1 MAY 51, WHICH MAY BE USED

TM 976-70

Figure 70. DA Form 11-261.

CHAPTER 5

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

66. Preparation for Storage or Shipment

a. If Power Unit PU–26A/U is not to be used for 30 days or more, or is to be transported to a remote point, rustproof the equipment as instructed in paragraph 38.

b. After the unit has been processed (par. 38) inspect the finish for possible damage. If any damage to the finish is noted, refinish as instructed in paragraph 39.

c. When the operations in *a* and *b* above have been completed, place the equipment in its canvas cover and fasten the cover securely. See that all tools and spare parts are present and in good condition; replace any that are missing. Wrap each tool and spare part in a moistureproof wrapping and mark it for identification.

67. Shipment

a. If the shipment is to be moved a short distance by truck or trailer, no crating will be required. However, protect the equipment with a tarpaulin or other suitable covering.

b. If the equipment is to be shipped a considerable distance, pack it in suitable crates or boxes in accordance with applicable joint Army-Navy specifications.

68. Destruction of Components

When ordered by your commander, destroy all equipment to prevent its being used or salvaged by the enemy.

a. Smash. Smash cylinder block, cylinder head, spark plugs, carburetor, muffler, air cleaner, oil and fuel filters, fuel pump, manifold, heater unit, radiator, governor, control panel, instrument panel, priming pump, distributor, change board and terminal boards, and storage batteries. Use sledges, axes, handaxes, pickaxes, hammers, crowbars, and heavy tools.

b. Cut. Cut remote fuel hose, remote control cables, engine and control panel wiring, connecting wires and cables, exhaust hose, fuel and oil lines, cooling system hose and canvas cover, and generator windings. Use axes, handaxes, and machetes.

c. Burn. Burn fuel, lubricants, canvas cover, packing cases, generator windings, wire and cables, technical manuals and all other literature and documents. Use gasoline, kerosene, oil, flame throwers, and incendiary grenades.

d. Dispose. Dispose of all remaining parts of equipment. Bury in slit trenches, fox holes, or other holes. Throw into streams. Scatter.

e. Destroy. Destroy everything.

INDEX

	Paragraphs	Page
Adjustments:		
Carburetor	25b(5), 62f	28, 114
Circuit breaker, mainload	18b(1)	19
Engine overspeed safety governor	62e	114
Engine-speed governor	25b(1), (2), (3)	26, 27
Ignition timing	61i, 62a	112, 114
Oil pressure	25b(6)	28
Valve tappet	62c	114
Valve timing	62b	114
Voltage regulator	25b(4)	27
Winterization system	62g	114
Adjustments prior to final testing (after overhaul.)	62	114
Air cleaner:		
Detailed inspection	54b	67
Installation	61n	113
Lubrication instructions	36b(2)	35
Service and maintenance:		
Arctic climate	27a(5)	30
Desert climate	28e	31
Stripping	53e	63
Ammeter, a-c. (*See* Instruments.)		
Ammeter, d-c. (*See* Instruments.)		
Application	4	4
Arctic operation. (*See* Operation, unusual conditions.		
Automatic choke. (*See* Choke, automatic.)		
Batteries:		
Charging procedure	17b	16
Connections	14c	15
Initial preparation	17a	16
Service, maintenance, and care:		
Arctic climate	27a(4)	30
Desert climate	28d	31
Temperature changes of specific gravity	17c	17
Tropical climate	29	31
Usual conditions	17, 46	16, 41
Weight and dimensions	8a	10
Battery charging rectifier	19d	22
Carburetor:		
Adjustments	25b(5), 62f	28, 114
Detailed inspection	54c	67
Installation	61c	111
Stripping	53f	63
Throttle linkage lubrication	36b(6)	36
Choke:		
Automatic. (*See* Controls: Engine: Automatic.)		
Manual. (*See* Controls: Engine: Manual.)		
Circuit breaker:		
Battery charging	18d(4)	21
Duplex receptacle	18d(2), 19e	21, 22
Heater reset	18c(1), 19c(1)	20, 22
Main load	18b(1), 19b(1)	19, 21
Cleaning (exterior of power unit	52	62
Clearances	55a	88
Compression test	46	41
Connections and interconnections:		
Battery connections	14c	15
Output connections obtainable	3	3
Power output connections	14a	13
Remote control connections	14b	15
Control panel description	5j	6
Controls:		
Engine:		
Automatic:		
Choke	19a(5)	21
Engine overspeed safety governor.	19a(2)	21
Engine-speed governor	19a(1)	21
High-coolant-temperature cutoff switch.	19a(3)	21
Low-oil-pressure cutoff switch.	19a(4)	21
Manual:		
Choke	18a(3)	18
Engine control switch	18a(1)	17
Manual throttle	18a(4)	18
Priming pump	18a(5)	19
START-STOP switch	18a(2)	17
Generator:		
Automatic:		
Circuit breaker	19b(1)	21
Voltage regulation system	19b(2)	22
Manual:		
Circuit breaker	18b(1)	19
Manual voltage control	18b(3)	20
Series-parallel change board.	18b(4)	20
Voltage regulator control	18b(2)	20
Wye-delta change board	18b(4)	20
Miscellaneous:		
Circuit breaker, battery-charging.	18d(4)	21
Circuit breaker, duplex receptacle.	18d(2), 19e	21, 22
Duplex receptacle	18d(1)	20
Panel light switch	18d(3)	21
Winterization system:		
Automatic	19c	22
Manual	18c	20

	Paragraphs	Page
Controls—Continued.		
Cooling system:		
Coolant system capacity	21*b*	24
Coolant-temperature gage	20*a*(2)	22
Description	5*c*	4
Preparation for use:		
Arctic climate	27*a*(3)	29
Desert climate	28*c*	31
Tropical climate	29	31
Usual conditions	16*b*	16
Theory of operation	47*d*	48
Corrosion preventives, removal	13	13
Crankcase, lubricating instructions	36*b*(1)	34
DA Form 460	2*b*(2)	3
DA Form 464	2*b*(2)	3
DA Form 464 services	46	41
DA Form 468	2*a*(2)	3
DD Form 6	2*a*(1)	3
DD Form 535	2*a*(3)	3
Demolition to prevent enemy use	68	121
Description of Power Unit	3	3
Desert operation	28	31
Detailed inspection of engine subassemblies:		
Air Cleaner	54*b*	67
Carburetor	54*c*	67
Engine fuel pump	54*e*	71
Engine overspeed safety governor	54*d*	71
Engine-speed governor	54*a*	56
Fuel filter	54*f*	73
Heater	54*j*	85
Igniter assembly	54*h*	73
Oil filter	54*g*	73
Starting motor	54*i*	80
Disassembly:		
Engine	58	95
Generator	56	89
Disconnecting load	26	29
Engine:		
Control switch, operation	18*a*(1)	17
Description	5*a*	4
Disassembly	58	95
Installation	59*m*	110
Reassembly	59	103
Removal	59	95
Specifications, condensed table	7*a*	9
Suppression	65*j*	116
Theory of operation	47*a*	46
Troubleshooting chart	49*a*	55
Engine-overspeed safety governor:		
Adjustments	62*e*	114
Description	19*a*(2)	21
Detailed inspection	54*d*	71
Installation	61*c*	111
Stripping	53*f*	63
Theory of operation	47*c*	48
Engine-speed governor:		
Adjustments	25*b*(1),(2), (3)	26, 27
Description	19*a*(1)	21
Engine-speed governor—Continued.		
Detailed inspection	54*a*	66
Installation	61*b*	111
Lubrication	36*b*(10)	38
Stripping	53*d*	63
Theory of operation	47*b*	48
Exhaust system:		
Connecting exhaust extension tube	12*b*	12
Description	5*g*	5
Factory lubricated parts	35	34
Fan belt and governor drive belt adjustment.	46	41
Field maintenance instructions:		
Adjustments prior to final testing	62	114
Cleaning exterior of unit	52	62
Detailed inspection	54	66
Disassembly of engine	58	95
Disassembly of generator	56	89
Final testing and inspection after overhaul.	63	115
Installation of subassemblies and accessories.	61	111
Preliminary inspection	51	62
Reassembly of engine	59	103
Reassembly of generator	60	110
Removal of engine	57	95
Stripping	53	62
Finishing and weatherproofing	64	116
Fire extinguisher, installation	12*e*	13
Fits and tolerances	55	88
Forms and records	2	3
Foundation:		
Mounting	12*a*	12
Preparation	10	11
Frame:		
Description	5*m*	8
Installation, upper frame	61*m*	113
Stripping, upper frame	53*a*	62
Suppression	65*p*	117
Frequency meter. (*See* Instruments.)		
Fuel Filter:		
Detailed inspection	54*f*	73
Installation	61*d*	112
Servicing	36*b*(4)	36
Stripping	53*i*	65
Fuel pump:		
Engine:		
Detailed inspection	54*e*	71
Installation	61*a*	111
Servicing	36*b*(5)	36
Stripping	53*g*	63
Heater:		
Detailed inspection	54*k*	87
Installation	47*i*(2)	53
Lubrication and servicing	61*k*(3)	113
Stripping	36*b*(9)	36
Suppression	53*n*	65
Theory of operation	65*f*	116

	Paragraphs	Page
Fuel supply:		
Connecting fuel hose	12*c*	12
Location	9*d*	11
Fuel system:		
Arctic operation	27*a*(1)	29
Description	5*b*	4
Desert operation	28*a*	31
Preparation	16*a*	15
Theory of operation	47*e*	49
Usual operation	21*a*	24
General inspection	21*i*	24
Generator:		
Description	5*k*	7
Disassembly and testing	56	89
Reassembly	60	110
Suppression	65*o*	117
Theory of operation	47*h*	52
Troubleshooting chart	49*b*	60
Governor drive belt tension	46	41
Governor, engine overspeed. (*See* Engine overspeed governor.)		
Governer, engine-speed. (*See* Engine-speed governor.)		
Hardware, mounting. (*See* Standard nuts, bolts, screws, and washers.)		
Heater. (*See* Winterization system.)		
Heater fuel pump. (*See* Fuel pump.)		
Heater operating indicator lamp	18*c*(3), 19*c*(2)	20, 21
High altitude operation	30	32
High-coolant-temperature cutoff switch:		
Adjustment	46	41
Description	19*a*(3)	21
Installation	61*h*	112
Stripping	53*j*	65
Suppression	65*l*	117
Theory	47*f*(4)	51
Igniter assembly:		
Description	5*e*	4
Detailed inspection	54*h*	73
Installation	61*i*	112
Lubrication	36*b*(8)	36
Stripping	53*l*	65
Suppression	65*a*	116
Ignition system:		
Description	5*e*	4
Timing	61*j*, 62*a*	113, 114
Indoor installation	9*c*	11
Initial lubrication	15	15
Installation equipment list	8*d*	10
Installation of subassemblies and accessories.	61	111
Instrument panel, description	5*i*	6
Instrument readings, normal	20	22
Instruments:		
Engine:		
Coolant-temperature gage	20*a*(2)	22
D-c ammeter	20*a*(3)	22
Oil-pressure gage	20*a*(1)	22
Instruments—Continued.		
Generator:		
Ammeter	20*b*(2)	23
Frequency meter	20*b*(3)	23
Running time meter	20*b*(4)	23
Voltmeter	20*b*(1)	23
Lamp, indicator, heater	18*c*(3), 19*c*(2)	20, 22
Load:		
Applying load	24	26
Disconnecting load	26	29
Relation to location	9*a*	11
Low-oil-pressure cutoff switch:		
Description	19*a*(4)	21
Installation	61*e*	112
Stripping	53*h*	63
Testing	46	41
Lubricants	33	33
Lubrication:		
Approved lubricants (chart)	33	33
Arctic climate	27*a*(2)	29
Desert climate	28*b*	31
Factory lubricated parts	35	34
Initial lubrication	15	15
Lubricating periods	34	34
Routine lubrication	36	34
Lubrication system:		
Description	5*d*	4
Theory of operation	47*g*	51
Maintenance. (*See* Field maintenance instructions and preventive maintenance.)		
Major parts and assemblies	5	4
Manual throttle. (*See* Controls: Engine: Manual.)		
Manual voltage control	18*b*(3)	20
Miscellaneous equipment list	8*e*	10
Mounting on foundation	12*a*	12
Muffler:		
Installation	61*f*	112
Stripping	53*c*	63
Oil filter:		
Detailed inspection	54*g*	73
Installation	61*g*	112
Servicing	36*b*(3)	35
Stripping	53*k*	65
Oil pressure:		
Adjustment	25*b*(6)	28
Cutoff switch	19*a*(4)	21
Normal operating pressure	20*a*(1)	22
Oil-pressure transmitter suppression.	65*k*	117
Oil-pressure gage. (*See* Instruments: Engine.)		
Operating procedure, usual	25	26
Operation:		
Usual conditions:		
Adjustments	35*b*	26
Applying load	24	26
Precautions after starting	23	26

	Paragraphs	Page
Operation—Continued.		
Usual conditions—Continued.		
Preliminary procedure	21	24
Starting	22	24
Stopping	26	29
Unusual conditions:		
Arctic climate	27	29
Desert climate	28	31
High altitude	30	32
Tropical	29	31
Outdoor installation	9*b*	11
Output connections	14*a*	13
Painting and refinishing	39	39
Panel light switch	18*d*(3)	21
Performance characteristics	6	9
Power Unit PU–26A/U:		
Application	4	4
Description	3	3
Description of major parts and assemblies:		
Control panel	5*j*	6
Cooling system	5*c*	4
Engine	5*a*	4
Exhaust system	5*g*	5
Frame	5*m*	8
Fuel system	5*b*	4
Generator	5*k*	7
Ignition system	5*e*	4
Instrument panel	5*i*	6
Lubrication system	5*d*	4
Radio-frequency suppression equipment.	5*l*	8
Starting system	5*f*	4
Winterization system	5*h*	5
Preparation of fuel system and cooling system.	16	15
Preventive maintenance:		
After operation	41*d*	41
Annual maintenance services	45	41
At halt	41*c*	40
Before operation	41*a*	40
DA Form 464 services	46	41
Daily maintenance services	41	40
Definition of preventive maintenance.	40	39
During operation	41*b*	40
Monthly maintenance services	43	41
Semiannual maintenance services	44	41
Weekly maintenance services	42	41
Priming pump operation	18*a*(5)	19
Radiator:		
Description	5*c*	4
Duct, installation	12*d*	13
Inspection and service	46	41
Installation	61*l*	113
Stripping	53*b*	63
Radio-frequency suppression:		
Equipment	65	116
Troubleshooting chart	49*d*	61
Reassembly:		
Engine	59	103
Generator	60	110
Rectifier, selenium (battery-charging)	19*d*	22
Reference, catalog	31	33
Refinishing	39	39
Remote control:		
Connections	14*b*	15
Starting	22*c*	26
Suppression	65*h*	116
Removal of corrosion preventives	13	13
Running time meter. (*See* Instruments: Generator.)		
Rustproofing	38	38
Scope	1	3
Series-parallel change board	18*b*(4), 14*a*	20, 13
Setting up equipment:		
Connecting exhaust tube	12*b*	12
Connecting fuel hose	12*c*	12
Installing fire extinguisher	12*e*	13
Installing radiator duct	12*d*	13
Mounting on foundation	12*a*	12
Shipment and limited storage	66, 67	121
Siting:		
Indoor installation	9*c*	11
Location of fuel supply	9*d*	11
Outdoor installation	9*b*	11
Relation to load	9*a*	11
Spare parts list	8*b*	10
Spark plugs:		
Cleaning and adjusting	46	41
Suppression	65*b*	116
Specifications, condensed table of:		
Engine	7*a*	9
Generator	7*b, c*	9, 10
Spring pressures	55*b*	88
START-RUN switch, winterization	18*c*(2)	20
START-STOP switch	18*a*(2)	17
Starting:		
Arctic climate	27*b*	30
Manual	22*b*	25
Precautions after	23	26
Remote	22*c*	26
Usual operation	22	24
Starting motor:		
Detailed inspection	54*i*	80
Installation	61*j*	113
Stripping	53*m*	65
Starting system:		
Description	5*f*	4
Theory of operation	47*f*	50
Stopping:		
Arctic climate	27*c*	31
Usual conditions	26	29
Stripping	53	62
Suppression, radio-frequency:		
Description, general	51, 65	62, 116
Troubleshooting chart	49*d*	61
Tabular data	8	10

	Paragraphs	Page
Temperature gage, engine coolant	20a(2)	22
Testing and inspection after overhaul	63	115
Theory of operation:		
Cooling system	47d	48
Engine	47a	46
Engine overspeed safety governor	47c	48
Engine-speed governor	47b	48
Fuel system	47e	49
Generator	47h	52
Lubrication system	47g	51
Starting system	47f	50
Winterization system	47i	53
Throttle, manual operation	18a(4)	18
Tolerances (*See* Fits and tolerances.)		
Tools:		
Improvised tools	32	33
List	8c	10
Use and care	32a, b	33
Tropical operation	29	31
Troubleshooting chart	49	55
Troubleshooting:		
Meaning	48	55
Troubleshooting chart:		
Engine	49a	55
Generator	49b	60
Radio-frequency suppression equipment.	49d	61
Winterization system	49c	61
Uncrating, unpacking, and checking	11	11
Vacuum test	46, 49	41, 55
Valve tappet adjustment	62c	114
Valve timing	62b	114
Velocity type overspeed safety governor. (*See* Controls: Engine: Automatic.)		
Voltage regulation system	19b(2)	22
Voltage regulator:		
Adjustment	25b(4)	27
Control	18b(2)	20
Description and theory of operation.	47h	52
Suppression	65i	116
Voltmeter. (*See* Instruments: Generator.)		
Weatherproofing	37, 64	38, 116
Weights and dimensions	8a	10
Winterization system:		
Adjustments:		
Flame switch	62g(2)	115
Fuel control valve	62g(1)	115
Controls:		
Automatic	19c	22
Manual	18c	20
DA Form 464 services	46	41
Description	5h	5
Heater, detailed inspection	54j	85
Heater operating indicator lamp	18c(3)	20
Heater radio-frequency suppression.	65g	116
Installation	61k	113
Stripping	53n	65
Suppression	65f, g	116
Theory of operation	47i	53
Troubleshooting chart	49c	61
Wrench tension	55c	89
Wye-delta change board	18b(4), 14a	20, 13

[AG 412.42 (19 Apr 54)]

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